Module Handbook
Master Program Mechanical Engineering (M.Sc.)
SPO 2016, for study beginners since summer term 2019
Valid from Winter Term 2021/22
Date: 15/09/2021

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 module partial examinations have been passed. In the case of modules which offer alternative partial examinations, the module examination is concluded with the examination with which the required total credit points are reached or exceeded. The module grade, however, is combined with the weight of the predefined credit points for the module in the overall grade calculation.

1.1.2 Module versions

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

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

1.1.3 General and partial examinations

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

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

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

1.1.4 Types of exams

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

1.1.5 Repeating exams

Principally, a failed written exam, oral exam or alternative exam assessment can repeated only once. If the repeat examination (including an eventually provided verbal repeat examination) will be failed as well, the examination claim is lost. A request for a second repetition has to be made in written form to the examination committee two months after loosing the examination claim.
1.1.6 Additional accomplishments
Additional accomplishments are voluntarily taken exams, which have no impact on the overall grade of the student and can take place on the level of single courses or on entire modules. It is also mandatory to declare an additional accomplishment as such at the time of registration for an exam.

1.1.7 Further information
More detailed information about the legal and general conditions of the program can be found in the examination regulation of the program (http://www.sle.kit.edu/amtlicheBekanntmachungen.php).
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Universität des Landes Baden-Württemberg und nationales Forschungszentrum in der Helmholtz-Gemeinschaft
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Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudienengang Maschinenbau

vom 04. August 2015


Der Präsident hat seine Zustimmung gemäß § 20 Absatz 2 KITG iVm. § 32 Absatz 3 Satz 1 LHG am 04. August 2015 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) Im konsekutiven Masterstudium sollen die im Bachelorstudium erworbenen wissenschaftlichen Qualifikationen weiter vertieft, verbreitet, erweitert oder ergänzt werden. 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.
(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 deutschsprachige Wahlmöglichkeiten gibt.

§ 4 Modulprüfungen, Studien- und Prüfungsleistungen
Erfolgskontrollen gliedern sich in Studien- oder Prüfungsleistungen.
(2) Prüfungsleistungen sind:
1. schriftliche Prüfungen,
2. mündliche Prüfungen oder
3. Prüfungsleistungen anderer Art.

(3) Studienleistungen sind schriftliche, mündliche oder praktische Leistungen, die von den Studierenden in der Regel lehrveranstaltungsbegleitend erbracht werden. Die Masterprüfung darf nicht mit einer Studienleistung abgeschlossen werden.

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

(5) Bei sich ergänzenden Inhalten können die Modulprüfungen mehrerer Module durch eine auch modulübergreifende Prüfungsleistung (Absatz 2 Nr.1 bis 3) ersetzt werden.

§ 5 Anmeldung und Zulassung zu den Modulprüfungen und Lehrveranstaltungen

(1) Um an den Modulprüfungen teilnehmen zu können, müssen sich die Studierenden online im Studierendenportal zu den jeweiligen Erfolgskontrollen anmelden. In Ausnahmefällen kann eine Anmeldung schriftlich im Studierendenservice oder in einer anderen vom Studierendenservice autorisierten Einrichtung erfolgen. Für die Erfolgskontrollen können durch die Prüfenden Anmeldefristen festgelegt werden. Die Anmeldung der Masterarbeit ist im Modulhandbuch geregelt.


(3) Zu einer Erfolgskontrolle ist zuzulassen, wer
1. in den Masterstudiengang Maschinenbau am KIT eingeschrieben ist; die Zulassung beurlaubter Studierender ist auf Prüfungsleistungen 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) Nach Maßgabe von § 30 Abs. 5 LHG kann die Zulassung zu einzelnen Pflichtveranstaltungen beschränkt werden. 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 § 13 Abs. 1 Satz 1 und 2, sofern ein Abbau des Überhangs durch andere oder zusätzliche Veranstaltungen nicht möglich ist. Für den Fall gleichen Studienfortschritts sind durch die KIT-Fakultäten weitere Kriterien festzulegen. Das Ergebnis wird den Studierenden rechtzeitig bekannt gegeben.


§ 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) Die Art der Erfolgskontrolle (§ 4 Abs. 2 Nr. 1 bis 3, Abs. 3) wird von der/dem Prüfenden der betreffenden Lehrveranstaltung in Bezug auf die Lerninhalte der Lehrveranstaltung und die Lernziele des Moduls festgelegt. 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. Im Einvernehmen von Prüfendem und Studierender bzw. Studierendem können die Art der Prüfungsleistung sowie die Prüfungssprache auch nachträglich geändert werden; im ersten Fall ist jedoch § 4 Abs. 4 zu beachten. Bei der Prüfungsorganisation sind die Belange Studierender mit Behinderung oder chronischer Erkrankung gemäß § 13 Abs. 1 zu berücksichtigen. § 13 Abs. 1 Satz 3 und 4 gelten entsprechend.

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

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


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

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

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.

Schriftliche Arbeiten im Rahmen einer Prüfungsleistung anderer Art haben dabei die folgende Erklärung zu tragen: „Ich versichere wahrheitsgemäß, die Arbeit selbständig angefertigt, alle benutzten Hilfsmittel vollständig und genau angegeben und alles kenntlich gemacht zu haben, was aus Arbeiten anderer unverändert oder mit Abänderungen entnommen wurde.“ Trägt die Arbeit diese Erklärung nicht, wird sie nicht angenommen. Die wesentlichen Gegenstände und Ergebnisse einer solchen Erfolgskontrolle sind in einem Protokoll festzuhalten.

§ 6 a Erfolgskontrollen im Antwort-Wahl-Verfahren
Das Modulhandbuch regelt, ob und in welchem Umfang Erfolgskontrollen im Wege des Antwort-Wahl-Verfahrens abgelegt werden können.

§ 6 b Computergestützte Erfolgskontrollen


(2) Vor der computergestützten Erfolgskontrolle hat die/der Prüfende sicherzustellen, dass die elektronischen Daten eindeutig identifiziert und unverwechselbar und dauerhaft den Studierenden zugeordnet werden können. Der störungsfreie Verlauf einer computergestützten Erfolgskontrolle ist durch entsprechende technische Betreuung zu gewährleisten, insbesondere ist die Erfolgskontrolle in Anwesenheit einer fachlich sachkundigen Person durchzuführen. Alle Prüfungsaufgaben müssen während der gesamten Bearbeitungszeit zur Bearbeitung zur Verfügung stehen.

(3) Im Übrigen gelten für die Durchführung von computergestützten Erfolgskontrollen die §§ 6 bzw. 6 a.

§ 7 Bewertung von Studien- und Prüfungsleistungen

(1) Das Ergebnis einer Prüfungsleistung wird von den jeweiligen Prüfenden in Form einer Note festgesetzt.

(2) 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.

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.
Eine Prüfungsleistung ist bestanden, wenn die Note mindestens „ausreichend“ (4,0) ist.


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

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

Die Gesamtnote der Masterprüfung, die Fachnoten und die Modulnoten lauten:

<table>
<thead>
<tr>
<th>Note</th>
<th>Modulnoten</th>
</tr>
</thead>
<tbody>
<tr>
<td>sehr gut</td>
<td>bis 1,5</td>
</tr>
<tr>
<td>gut</td>
<td>von 1,6 bis 2,5</td>
</tr>
<tr>
<td>befriedigend</td>
<td>von 2,6 bis 3,5</td>
</tr>
<tr>
<td>ausreichend</td>
<td>von 3,6 bis 4,0</td>
</tr>
</tbody>
</table>

§ 8 Wiederholung von Erfolgskontrollen, endgültiges Nichtbestehen

(1) Studierende können eine nicht bestandene schriftliche Prüfung (§ 4 Absatz 2 Nr. 1) einmal wiederholen. Wird eine schriftliche Wiederholungsprüfung mit „nicht ausreichend“ (5,0) bewertet, so findet eine mündliche Nachprüfung im zeitlichen Zusammenhang mit dem Termin der nicht bestandenen Prüfung statt. In diesem Falle kann die Note dieser Prüfung nicht besser als „ausreichend“ (4,0) sein.

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

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

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

(5) Studienleistungen können mehrfach wiederholt werden.

(6) Die Wiederholung von Prüfungsleistungen hat spätestens bis zum Ende des Prüfungszeitraumes des übernächsten Semesters zu erfolgen.

(7) Die Prüfungsleistung ist endgültig nicht bestanden, wenn die mündliche Nachprüfung im Sinne des Absatzes 1 mit „nicht ausreichend“ (5,0) bewertet wurde. 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.

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

(9) Eine zweite Wiederholung derselben Prüfungsleistung gemäß § 4 Abs. 2 ist nur in Ausnahmefällen auf Antrag des/der Studierenden zulässig („Antrag auf Zweitwiederholung“). Der Antrag ist schriftlich beim Prüfungsausschuss in der Regel bis zwei Monate nach Bekanntgabe der Note zu stellen.

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

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


§ 9 Verlust des Prüfungsanspruchs

Ist eine nach dieser Studien- und Prüfungsordnung erforderliche Studien- oder Prüfungsleistung endgültig nicht bestanden oder eine Wiederholungsprüfung nach § 8 Abs. 6 nicht rechtzeitig erbracht oder die Masterprüfung bis zum Ende des Prüfungszeitraums des siebten Fachsemesters einschließlich etwaiger Wiederholungen nicht vollständig abgelegt, so erlischt der Prüfungsanspruch im Studiengang Maschinenbau, es sei denn, dass die Fristüberschreitung nicht selbst zu vertreten ist. Die Entscheidung über eine Fristverlängerung und über Ausnahmen von der Fristregelung trifft der Prüfungsausschuss unter Beachtung der in § 32 Abs. 6 LHG genannten Tätigkeiten auf Antrag des/der Studierenden. Der Antrag ist schriftlich in der Regel bis sechs Wochen vor Ablauf der Frist zu stellen.

§ 10 Abmeldung; Versäumnis, Rücktritt


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

(4) 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. Dasselbe gilt, wenn die Masterarbeit nicht innerhalb der vorgesehenen Bearbeitungszeit erbracht wird, es sei denn, der/die Studierende hat die Fristüberschreitung nicht zu vertreten.


§ 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) 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. In diesem Fall gilt die betreffende Erfolgskontrolle als mit „nicht ausreichend“ (5,0) bewertet.
§ 12 Mutterschutz, Elternzeit, Wahrnehmung von Familienpflichten


(3) Der Prüfungsausschuss entscheidet auf Antrag über die flexible Handhabung von Prüfungsfristen entsprechend den Bestimmungen des Landeshochschulgesetzes, wenn Studierende Familienpflichten wahrzunehmen haben. Absatz 2 Satz 4 bis 6 gelten entsprechend.

§ 13 Studierende mit Behinderung oder chronischer Erkrankung


(2) Weisen Studierende eine Behinderung oder chronische Erkrankung nach und folgt daraus, dass sie nicht in der Lage sind, Erfolgskontrollen ganz oder teilweise in der vorgeschriebenen Zeit oder Form abzulegen, kann der Prüfungsausschuss gestatten, die Erfolgskontrollen in einem anderen Zeitraum oder einer anderen Form zu erbringen. Insbesondere ist behinderten Studierenden zu gestatten, notwendige Hilfsmittel zu benutzen.

(3) Weisen Studierende eine Behinderung oder chronische Erkrankung nach und folgt daraus, dass sie nicht in der Lage sind, die Lehrveranstaltungen regelmäßig zu besuchen oder die gemäß § 19 erforderlichen Studien- und Prüfungsleistungen zu erbringen, kann der Prüfungsausschuss auf Antrag gestatten, dass einzelne Studien- und Prüfungsleistungen nach Ablauf der in dieser Studien- und Prüfungsordnung vorgesehenen Fristen absolviert werden können.
§ 14 Modul Masterarbeit

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

(1 a) Dem Modul Masterarbeit sind 30 LP zugeordnet. Es besteht aus der Masterarbeit und einer Präsentation. Die Präsentation hat spätestens sechs Wochen nach Abgabe der Masterarbeit zu erfolgen.


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


(5) 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. Wenn diese Erklärung nicht enthalten ist, wird die Arbeit nicht angenommen. Die Erklärung kann wie folgt lauten: „Ich versichere wahrheitsgemäß, die Arbeit selbstständig verfasst, alle benutzten Hilfsmittel vollständig und genau angegeben und alles kenntlich gemacht zu haben, was aus Arbeiten anderer verändert oder mit Abänderungen entnommen wurde sowie die Satzung des KIT zur Sicherung guter wissenschaftlicher Praxis in der jeweils gültigen Fassung beachtet zu haben.“ Bei Abgabe einer unwahren Versicherung wird die Masterarbeit mit „nicht ausreichend“ (5,0) bewertet.


(7) Die Masterarbeit wird von mindestens einem/einer Hochschullehrer/in oder einem/einer leitenden Wissenschaftler/in gemäß § 14 abs. 3 Ziff. 1 KITG und einem/einer weiteren Prüfenden bewertet. In der Regel ist eine/r der Prüfenden die Person, die die Arbeit gemäß Absatz 2 geben hat. Bei nicht übereinstimmender Beurteilung dieser beiden Personen setzt der Prüfungs-
ausschuss im Rahmen der Bewertung dieser beiden Personen die Note der Masterarbeit fest; er kann auch einen weiteren Gutachter bestellen. Die Bewertung hat innerhalb von sechs Wochen nach Abgabe der Masterarbeit zu erfolgen.

§ 15 Zusatzleistungen


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

§ 16 Prüfungsausschuss


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

(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 prüfungs- berechtigte Person hinzuzuziehen.


§ 17 Prüfende und Beisitzende

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

(2) Prüfende sind Hochschullehrer/innen sowie leitende Wissenschaftler/innen gemäß § 14 Abs. 3 Ziff. 1 KITG, habilitierte Mitglieder und akademische Mitarbeiter/innen gemäß § 52 LHG, welche der KIT-Fakultät angehören und denen die Prüfungsbeauftragung übertragen wurde; desgleichen kann wissenschaftlichen Mitarbeitern gemäß § 14 Abs. 3 Ziff. 2 KITG die Prüfungsbeauftragung übertragen werden. 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, können diese zu Prüfenden bestellt werden, sofern die KIT-Fakultät eine Prüfungsbeauftragung erteilt hat und die gemäß Absatz 2 Satz 2 vorausgesetzte Qualifikation nachweisen können.

(4) Die Beisitzenden werden durch die Prüfenden benannt. Zu Beisitzenden darf nur bestellt werden, wer einen akademischen Abschluss in einem mathematisch-naturwissenschaftlichen oder ingenieurwissenschaftlichen Studiengang oder einen gleichwertigen akademischen Abschluss erworben hat.

§ 18 Anerkennung von Studien- und Prüfungsleistungen, Studienzeiten

(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. Dabei ist kein schematischer Vergleich, sondern eine Gesamtbetrachtung zu nehmen. Bezüglich des Umfangs einer zur Anerkennung vorgelegten Studienleistung bzw. Prüfungsleistung (Anrechnung) werden die Grundsätze des ECTS herangezogen.

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

(3) Werden Leistungen angerechnet, die nicht am KIT erbracht wurden, werden sie im Zeugnis als „anerkannt“ ausgewiesen. Liegen Noten vor, werden die Noten, soweit die Notensysteme vergleichbar sind, übernommen und in die Berechnung der Modulnoten und der Gesamtnote einbezogen. Sind die Notensysteme nicht vergleichbar, können die Noten umgerechnet werden. 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 Hochschul-
II. Masterprüfung

§ 19 Umfang und Art der Masterprüfung
(1) Die Masterprüfung besteht aus den Modulprüfungen nach Absatz 2 und 3 sowie der Modul Masterarbeit (§ 14).
(2) Es sind Modulprüfungen im Pflichtfach „Vertiefung ingenieurwissenschaftlicher Grundlagen“ im Umfang von 50 LP abzulegen. Die Festlegung der zur Auswahl stehenden Module wird im Modulhandbuch getroffen.
(3) Im Wahlpflichtbereich ist ein Wahlpflichtfach im Umfang von 40 LP zu absolvieren. Zur Auswahl steht mindestens das Fach „Allgemeiner Maschinenbau“. Die Festlegung der weiteren zur Auswahl stehenden Fächer und der den Fächern zugeordneten Module wird im Modulhandbuch getroffen.

§ 20 Bestehen der Masterprüfung, Bildung der Gesamtnote
(1) Die Masterprüfung ist bestanden, wenn alle in § 19 genannten Modulprüfungen mindestens mit „ausreichend“ bewertet 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
(2) Das Zeugnis enthält die Fach- und Modulnoten sowie die den Modulen und Fächern zugeordnete Leistungspunkte und die Gesamtnote. Sofern gemäß § 7 Abs. 2 Satz 2 eine differenzier-

(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.


III. Schlussbestimmungen

§ 22 Bescheinigung von Prüfungsleistungen

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. Dasselbe gilt, wenn der Prüfungsanspruch erloschen ist.

§ 23 Aberkennung des Mastergrades

(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. Gegebenenfalls kann die Modulprüfung für „nicht ausreichend“ (5,0) und die Masterprüfung für „nicht bestanden“ erklärt werden.

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


(6) Die Aberkennung des akademischen Grades richtet sich nach § 36 Abs. 7 LHG.
§ 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. Oktober 2016 in Kraft.


Karlsruhe, den 04. August 2015

Professor Dr.-Ing. Holger Hanselka
(Präsident)
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Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Master-studiengang Maschinenbau 28
Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Maschinenbau

vom 21. Februar 2019


Der Präsident hat seine Zustimmung gemäß § 20 Absatz 2 Satz 1 KITG i.V.m. § 32 Absatz 3 Satz 1 LHG am 21. Februar 2019 erteilt.

Artikel 1 – Änderung der Studien- und Prüfungsordnung

1. § 12 Absatz 1 wird wie folgt geändert:
   a) Satz 1 wird wie folgt gefasst:
      „Es gelten die Vorschriften des Gesetzes zum Schutz von Müttern bei der Arbeit, in der Ausbildung und im Studium (Mutterschutzgesetz – MuSchG) in seiner jeweils geltenden Fassung.“
   b) Satz 2 wird aufgehoben.
   c) Die bisherigen Sätze 3 und 4 werden die Sätze 2 und 3

2. § 14 wird wie folgt geändert:
   a) In Absatz 2 Satz 1 werden nach den Wörtern „Hochschullehrer/innen“ das Wort “und“ durch ein Komma ersetzt und nach der Angabe „§ 14 Abs. 3 Ziff. 1 KITG“ die Wörter „und habilitierten Mitgliedern der KIT-Fakultät für Maschinenbau“ eingefügt.
   b) In Absatz 7 Satz 1 werden nach den Wörtern „Hochschullehrer/innen“ das Wort “oder“ durch ein Komma ersetzt und nach der Angabe „§ 14 Abs. 3 Ziff. 1 KITG“ die Wörter „oder einem habilitierten Mitglied der KIT-Fakultät für Maschinenbau“ eingefügt.

3. § 16 wird wie folgt geändert:
   a) In Absatz 1 Satz 3 wird das Wort „stammt“ durch die Wörter „stammen soll“ ersetzt.
   b) In Absatz 7 Satz 4 werden nach dem Wort „Entscheidung“ die Wörter „schriftlich oder zur Niederschrift“ gestrichen.
4. § 17 Absatz 3 wird wie folgt geändert:
Nach dem Wort „sofern“ werden die Wörter „die KIT-Fakultät eine Prüfungsbeugniss erteilt hat und“ gestrichen.

Artikel 2 – Inkrafttreten

Diese Änderungssatzung tritt zum 01. April 2019 in Kraft.

Karlsruhe, den 21. Februar 2019

gerz. Prof. Dr.-Ing. Holger Hanselka
(Präsident)
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Satzung für den Zugang zu dem Masterstudiengang Maschinenbau am Karlsruher Institut für Technologie (KIT)
vom 22. November 2017


§ 1 Anwendungsbereich

Die Satzung regelt den Zugang zu dem Masterstudiengang Maschinenbau 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 Immatrikulation einschließlich aller erforderlichen Unterlagen muss

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

beim KIT eingegangen sein.

§ 3 Form des Antrages

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

(2) 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 18-wöchiges Berufspraktikum, welches durch die Praktikantenamt der KIT-Fakultät für Maschinenbau anerkannt wurde (§ 6),

4. eine schriftliche 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 a) oder b) genannten Sprachkenntnisse,

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

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


In diesem Fall sind die bis zu diesem Zeitpunkt erbrachten Studien- und Prüfungsleistungen im Rahmen der Zugangsentscheidung zu berücksichtigen. Das spätere Ergebnis des Bachelorabschlusses bleibt unbeachtet. 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 mit Angabe des Prüfungsdatums und des Nachweises der Prüfungsanmeldung beizulegen.

§ 4 Zugangskommission


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


§ 5 Zugangsvoraussetzungen

(1) Voraussetzungen für den Zugang zum Masterstudiengang Maschinenbau sind:
1. Ein bestandener Bachelorabschluss oder mindestens gleichwertiger Abschluss in dem Studiengang Maschinenbau oder einem Studiengang mit im Wesentlichen gleichem Inhalt 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 18-wöchiges Berufspraktikum, welches durch das Praktikantenamt der KIT-Fakultät für Maschinenbau anerkannt wurde (§ 6);

3. notwendige durch den Bachelorabschluss vermittelte 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. für Bewerber/innen, deren Muttersprache nicht Deutsch oder Englisch ist, der Nachweis von
   a) ausreichenden Kenntnissen der deutschen Sprache gemäß den Voraussetzungen der Zulassungs- und Immatrikulationsordnung des KIT oder

§ 6 Berufspraktikum


(2) 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.

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

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

1. Wärmebehandlung,
2. Werkzeug- und Vorrichtungsbau,
3. Planung von Instandhaltung, Wartung und Reparatur,
4. Planung von Messen, Prüfen und Qualitätskontrolle,
5. Oberflächentechnik,
6. Entwicklung, Konstruktion und Arbeitsvorbereitung,
7. Montage/ Demontageplanung und
8. andere fachrichtungsbezogene Tätigkeiten

Näheres regelt die Praktikumsordnung für den Bachelor- und Masterstudiengang Maschinenbau der KIT-Fakultät für Maschinenbau.


§ 7 Mindestkenntnisse und Mindestleistungen

(1) Die Zulassung zum Masterstudiengang Maschinenbau setzt den Nachweis voraus, dass sich der/die Bewerber/in mindestens in folgenden Fächern Fähigkeiten erworben hat, die nach Maßgabe der Lernziele, Inhalte und Leistungspunkte entsprechend des aktuellen Modulhandbuchs des Bachelorstudiengangs Maschinenbau zu denen im Bachelorstudiengang Maschinenbau am KIT gleichwertig sind:

1. Höhere Mathematik
2. Technische Thermodynamik und Wärmeübertragung
3. Technische Mechanik
4. Maschinenkonstruktionslehre
5. Werkstoffkunde
6. Strömungslehre
7. Mess- und Regelungstechnik
8. Elektrotechnik

Über die Gleichwertigkeit nach Satz 1 entscheidet die Zugangskommission des Masterstudiengangs Maschinenbau im Benehmen mit dem Prüfungsausschuss des Masterstudiengangs Maschinenbau.

(2) 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 schriftlichen Aufnahmeprüfung gemäß Anlage 1 am KIT nachweisen. Für einen erfolgreichen Nachweis darf die erfolgreiche Teilnahme an der Aufnahmeprüfung nicht länger als vier Bewerbungsverfahren zurückliegen. 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) 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 Abs. 2 Nr. 2 LHG, § 9 Abs. 2 HZG).
Im Fall des § 3 Abs. 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. Wird der Nachweis nicht fristgerecht erbracht, erlischt die Zusicherung, und eine Immatrikulation erfolgt nicht. Hat die/der Bewerber/in die Fristüberschreitung nicht zu vertreten, hat sie/er dies gegenüber der Zugangskommission zu belegen und schriftlich nachzuweisen. Die Zugangskommission kann im begründeten Einzelfall die Frist für das Nachreichen des endgültigen Zeugnisses verlängern.

(3) 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. 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 geltenden Bestimmungen in der Zulassungs- und Immatrikulationsordnung des KIT unberührt.

§ 9 Inkrafttreten


Karlsruhe, den 22. November 2017

Prof. Dr. Holger Hanselka
(Präsident)
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

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 genaue Prüfungstermine und der Ort der Aufnahmeprüfung werden mindestens sechs Wochen vor dem Prüfungstermin durch das KIT auf den Internetseiten der KIT-Fakultät für Maschinenbau bekannt gegeben.


4.3 Zur Bewertung der Aufnahmeprüfung setzt die Zugangskommission (§ 4) eine Prüfungskommission ein. Sie besteht aus mindestens zwei stimmberechtigten Mitgliedern, einem/einer Hochschullehrer/in / leitenden/leitender Wissenschaftler/in gemäß § 14 Abs. 3 Ziff. 1 KITG / Privatdozentin bzw. -dozenten, und einer akademischen Mitarbeiterin/ einem aka-


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 75 Punkte, dabei mindestens 15 Punkte in jedem der vier Teilbereiche 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.
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Satzung zur Änderung der Satzung für den Zugang zu dem Masterstudiengang Maschinenbau am Karlsruher Institut für Technologie (KIT)

vom 28. November 2018


Artikel 1

1. § 3 Abs. 2 Ziff. 3 wird wie folgt geändert:

Nach dem Wort „Berufspraktikum“ werden die Worte „welches durch das Praktikantenamt der KIT-Fakultät für Maschinenbau anerkannt wurde“ gestrichen.

2. § 5 Abs. 1 Ziff. 3 wird wie folgt geändert:

Nach dem Wort „notwendige“ werden die Worte „durch den Bachelorabschluss vermittelte“ gestrichen.

3. § 5 Abs. 1 Ziff. 5 Buchst. b) erhält folgende Fassung:

„b) ausreichenden englischen Sprachkenntnisse, die mindestens dem Niveau B2 des Gemeinsamen Europäischen Referenzrahmens für Sprachen (GER) oder gleichwertig entsprechen, nachgewiesen beispielsweise durch einen der folgenden international anerkannten Tests:  
aa) Test of English as Foreign Language (TOEFL) mit mindestens 550 Punkten im paper-based Test, oder 88 Punkten im internet-based Test oder  
bb) IELTS mit einem Gesamtergebnis von mindestens 6.5 und keiner Section unter 5.5.  
Der Nachweis englischer Sprachkenntnisse entfällt für Bewerber/innen, die ihren Bachelorabschluss in einem englischsprachigen Studiengang oder im englischsprachigen Ausland erworben haben. Die offizielle Sprache des Studiengramms muss auf dem Abschlusszeugnis, dessen Ergänzung, im Transcript of Records oder in einer entsprechenden Bescheinigung der Hochschule vermerkt sein.“

4. § 6 Abs. 5 erhält folgende Fassung:

„(5) 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. Eine etwaige Auflage wird von der Zulassungskommission festgesetzt und der/dem Bewerber/in im Rahmen der Zulassung mitgeteilt.“
5. **Anlage 1 Ziff. 5.1 erhält folgende Fassung:**

   „5.1 Die Aufnahmeprüfung ist bestanden, wenn die/der Bewerber/in mindestens 50 Punkte, dabei mindestens 12 Punkte in jedem der vier Teilbereiche erreicht.“

**Artikel 2**


Karlsruhe, 28. November 2018

**gez. Prof. Dr. Holger Hanselka**

**(Präsident)**
Inhalt

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

vom 29. Juli 2019


Artikel 1

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

Artikel 2

Karlsruhe, 29. Juli 2019

gez. Prof. Dr. Holger Hanselka
(Präsident)
Studienplan der KIT-Fakultät für Maschinenbau für den Masterstudiengang Maschinenbau gemäß SPO 2015
Fassung vom 31. März 2020

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## 0 Abkürzungsverzeichnis

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1 Studienpläne, Module und Prüfungen

Das Masterstudium kann sowohl zum Winter- als auch zum Sommersemester aufgenommen werden. Wegen der freien Wahl der Module lässt sich für das Masterstudium kein exemplarischer Studienverlauf angeben.

Die Angabe der Leistungspunkte (LP) erfolgt gemäß dem „European Credit Transfer and Accumulation System“ (ECTS) und basiert auf dem von den Studierenden zu absolvierenden Arbeitspensum.

1.1 Prüfungsmodalitäten

In jedem Semester wird für Prüfungen mindestens ein Prüfungstermin angeboten. Prüfungstermine sowie Termine, zu denen die Anmeldung zu den Prüfungen spätestens erfolgen muss, werden vom Prüfungsausschuss festgelegt. Die Anmeldung für die Prüfungen erfolgt in der Regel mindestens eine Woche vor der Prüfung. Anmelde- und Prüfungstermine werden rechtzeitig bekanntgegeben, bei schriftlichen Prüfungen mindestens 6 Wochen vor der Prüfung.


Studienleistungen können solange beliebig oft wiederholt werden, bis diese erfolgreich absolviert wurden.

Zur Berechnung der Modul- und Fachnoten wird auf §7 der SPO verwiesen. Die Modulnote errechnet sich dabei aus einem nach den Leistungspunkten der einzelnen Teilmodule gewichteten Notendurchschnitt. Die differenzierten Noten (s. SPO § 7, Abs. 2) sind bei der Berechnung der Modulnoten als Ausgangsdaten zu verwenden.

1.2 Vertiefungsrichtungen

Es stehen folgende Vertiefungsrichtungen zur Auswahl:

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<th>Abk.</th>
<th>Verantwortliche/r</th>
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### Folgende Module sind im Masterstudiengang zu belegen:

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<th>Modul</th>
<th>LP/Modul</th>
<th>Teilleistung</th>
<th>LP</th>
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### Vertiefung ingenieurwissenschaftlicher Grundlagen

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1 Bei der Veranstaltung „WahrStudienleistungstheorie und Statistik“ beträgt die Prüfungsdauer abweichend 1,5 h.

2 Zugelassene Teilleistungen in den Wahlpflichtmodulen
Jedes Fach, jedes Modul und jede Teilleistung kann nur einmal im Rahmen des Bachelorstudienganges und des konsekutiven Masterstudiengangs Maschinenbau gewählt werden.

2.1 Wahlpflichtmodul Grundlagen und Methoden der Vertiefungsrichtung
Im Masterstudiengang müssen zwei Teilleistungen mit jeweils 4 LP im Modul Grundlagen und Methoden der jeweiligen Vertiefungsrichtung erbracht werden. Wählbare Teilleistungen siehe Modulhandbuch.

2.2 Mathematische Methoden
Wählbare Teilleistungen siehe Modulhandbuch.

2.3 Wahlpflichtmodul aus dem Bereich Naturwissenschaften/Informatik/Elektrotechnik

2.4 Wahlpflichtmodul aus dem Bereich Wirtschaft/Recht

2.5 Wahlpflichtmodul aus dem Bereich Maschinenbau
Wählbare Teilleistungen siehe Modulhandbuch. Andere Teilleistungen, auch aus anderen Fakultäten, können mit Genehmigung des Prüfungsausschusses gewählt werden.

2.6 Laborpraktikum
Wählbare Teilleistungen siehe Modulhandbuch. Der Wechsel der gewählten Teilleistung ist bis zum Bestehen der Erfolgskontrolle möglich.

3 Schwerpunkte
Generell gilt, dass jede Teilleistung und jeder Schwerpunkt nur einmal entweder im Rahmen des Bachelorstudienganges und des konsekutiven Masterstudiengangs Maschinenbau gewählt werden kann.

3.1 Zuordnung der Schwerpunkte zu den Vertiefungsrichtungen
Folgende Schwerpunkte sind derzeit vom Fakultätsrat genehmigt. In einigen Vertiefungsrichtungen ist die Wahl des ersten Schwerpunkts eingeschränkt (einer der mit „p“ gekennzeichneten Schwerpunkte ist zu wählen).

In einem konsekutiven Masterstudium kann der erste Masterschwerpunkt auch als w-Schwerpunkt gewählt werden, wenn ein p-Schwerpunkt dieser Vertiefungsrichtung bereits im Bachelorstudium gewählt wurde.
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Für jeden Schwerpunkt werden Teilleistungen im Umfang von 16 LP gewählt, davon werden mindestens 8 LP im Kernbereich (K) erworben. „KP“ bedeutet, dass die Lehrveranstaltung im Kernbereich Pflicht ist, sofern sie nicht bereits belegt wurde. Die übrigen 8 LP können aus dem Ergänzungsbereich kommen. Dabei dürfen im Rahmen von Praktika höchstens 4 LP erworben werden, die auch als Studienleistung erbracht werden können.

Die im Ergänzungsbereich (E) angegebenen Teilleistungen verstehen sich als Empfehlung, andere Teilleistungen (auch aus anderen KIT-Fakultäten) können mit Genehmigung des jeweiligen Schwerpunktverantwortlichen gewählt werden.

Ein Absolvieren des Schwerpunktmoduls mit mehr als 16 LP ist nur im Fall, dass die Addition innerhalb des Schwerpunktmoduls nicht auf 16 LP aufgeht, erlaubt. Nicht zulässig ist es jedoch, noch weitere Teilleistungen anzumelden, wenn bereits 16 LP erreicht oder überschritten wurden.

Für die Prüfungsleistungen in den Schwerpunkten gelten folgende Regeln:
Die Prüfungen werden grundsätzlich mündlich abgenommen, bei unvertretbar hohem Prüfungsaufwand kann eine mündlich durchzuführende Prüfung auch schriftlich abgenommen werden. Es wird empfohlen, die Kernbereichsprüfung im Block abzulegen. Bei mündlichen Prüfungen im Schwerpunkt soll die Prüfungsdauer fünf Minuten pro Leistungspunkt betragen. Erstreckt sich eine mündliche Prüfung über mehr als 12 LP, soll die Prüfungsdauer 60 Minuten betragen.

## 4 Masterarbeit

Für die Betreuung der Masterarbeit stehen je nach Vertiefungsrichtung folgende Institute (●) zur Wahl:

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<th>Abk.</th>
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<th>E+UT</th>
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In interdisziplinär ausgerichteten Vertiefungsrichtungen ist die Beteiligung von Instituten anderer Fakultäten erwünscht. Mit Zustimmung der Vertiefungsrichtungsverantwortlichen kann der Prüfungsausschuss auch Masterarbeiten an anderen Instituten der Fakultät für Maschinenbau genehmigen. Zustimmung und Genehmigung sind vor Beginn der Arbeit einzuholen.
5 Exemplarischer Studienverlaufsplan


<table>
<thead>
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6 Änderungshistorie (ab 22.04.2015)

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## 8 Field of study structure

### Mandatory

<table>
<thead>
<tr>
<th>Course</th>
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<tr>
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<td>Advanced Engineering Fundamentals</td>
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<tr>
<td>Specialization</td>
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### 8.1 Master Thesis

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## 8.3 Specialization

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<tr>
<td>Energy- and Environment Engineering</td>
<td>40 CR</td>
</tr>
<tr>
<td>Vehicle Technology</td>
<td>40 CR</td>
</tr>
<tr>
<td>Mechatronics and Microsystems Technology</td>
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</tr>
<tr>
<td>Product Development and Engineering Design</td>
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<tr>
<td>Production Technology</td>
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<tr>
<td>Theoretical Mechanical Engineering</td>
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<td>Materials and Structures for High Performance Systems</td>
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### 8.3.1 Specialization: General Mechanical Engineering

**Part of:** Specialization

**Credits:** 40

#### Mandatory

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#### Election block: Major Fields (2 items)

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<tr>
<td>M-MACH-102646</td>
<td>Major Field: Applied Mechanics</td>
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<td>Major Field: Automation Technology</td>
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<td>Major Field: Rail System Technology</td>
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<td>Major Field: Computational Mechanics</td>
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<td>M-MACH-102642</td>
<td>Major Field: Development of Innovative Appliances and Power Tools</td>
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<td>Major Field: Engineering Design</td>
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<td>Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics</td>
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<td>Major Field: Combustion Engines Based Powertrains</td>
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<tr>
<td>M-MACH-102602</td>
<td>Major Field: Reliability in Mechanical Engineering</td>
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### 8.3.2 Specialization: Energy- and Environment Engineering

**Part of:** Specialization  
**Credits:** 40

#### Mandatory

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#### Election block: Major Field (1 item)

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# 8.3.3 Specialization: Vehicle Technology

## Part of: Specialization

### Credits

| Mandatory | 40 |

### Election block: Major Field (between 1 and 2 items)

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<td>M-MACH-102630</td>
<td>Major Field: Mobile Machines</td>
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### 8.3.4 Specialization: Mechatronics and Microsystems Technology

#### Part of: Specialization

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<td>Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics</td>
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<td>Major Field: Fundamentals of Energy Technology</td>
<td>16 CR</td>
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<td>M-MACH-102624</td>
<td>Major Field: Information Technology</td>
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<td>Major Field: Cognitive Technical Systems</td>
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<td>Major Field: Lifecycle Engineering</td>
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<td>Major Field: Microactuators and Microsensors</td>
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<td>16 CR</td>
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<tr>
<td>M-MACH-102612</td>
<td>Major Field: Modeling and Simulation in Energy- and Fluid Engineering</td>
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### 8.3.5 Specialization: Product Development and Engineering Design

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### 8.3.6 Specialization: Production Technology

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**Credits:** 40

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**Election block: Major Field (between 0 and 1 items)**

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### 8.3.7 Specialization: Theoretical Mechanical Engineering

**Part of:** Specialization  
**Credits:** 40  

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### 8.3.8 Specialization: Materials and Structures for High Performance Systems

**Part of:** Specialization  
**Credits:** 40  

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## 9.1 Module: Compulsory Elective Module Mechanical Engineering (MSc-Modul 04, WF) [M-MACH-102597]

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<td>Hydrogen Technologies</td>
<td>4 CR</td>
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<td>T-MACH-105443</td>
<td>Wave Propagation</td>
<td>4 CR</td>
<td>Seemann</td>
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<td>T-MACH-105211</td>
<td>Materials of Lightweight Construction</td>
<td>4 CR</td>
<td>Elsner, Liebig</td>
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<td>Materials Modelling: Dislocation Based Plasticity</td>
<td>4 CR</td>
<td>Weygand</td>
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<tr>
<td>T-MACH-100532</td>
<td>Scientific Computing for Engineers</td>
<td>4 CR</td>
<td>Gumbsch, Weygand</td>
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<td>T-MACH-105985</td>
<td>Ignition Systems</td>
<td>4 CR</td>
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<td>T-MACH-105406</td>
<td>Two-Phase Flow and Heat Transfer</td>
<td>4 CR</td>
<td>Schulenberg, Wömer</td>
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**Election block: Compulsory Elective Module Mechanical Engineering (Ü)**

<table>
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<th>Module Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Coordinator(s)</th>
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<tbody>
<tr>
<td>T-MACH-108887</td>
<td>Design and Development of Mobile Machines - Advance</td>
<td>0 CR</td>
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<td>T-MACH-108889</td>
<td>BUS-Controls - Advance</td>
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<tr>
<td>T-MACH-110928</td>
<td>Exercises for Applied Materials Simulation</td>
<td>2 CR</td>
<td>Gumbsch, Schneider</td>
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<tr>
<td>T-MACH-108888</td>
<td>Simulation of Coupled Systems - Advance</td>
<td>0 CR</td>
<td>Geimer, Xiang</td>
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<tr>
<td>T-MACH-110396</td>
<td>Strategic Product Development - Identification of Potentials of Innovative Products - Case Study</td>
<td>1 CR</td>
<td>Albers, Matthiesen, Siebe</td>
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<tr>
<td>T-MACH-111027</td>
<td>Tutorial Nonlinear Continuum Mechanics</td>
<td>1 CR</td>
<td>Böhlig</td>
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<tr>
<td>T-MACH-109304</td>
<td>Exercises - Fatigue of Welded Components and Structures</td>
<td>1 CR</td>
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<td>T-MACH-107671</td>
<td>Exercises for Applied Materials Simulation</td>
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<tr>
<td>T-MACH-107632</td>
<td>Exercises for Solid State Reactions and Kinetics of Phase Transformations</td>
<td>2 CR</td>
<td>Franke, Seifert</td>
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<td>T-MACH-110333</td>
<td>Tutorial Continuum Mechanics of Solids and Fluids</td>
<td>1 CR</td>
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<tr>
<td>T-MACH-110376</td>
<td>Tutorial Mathematical Methods in Continuum Mechanics</td>
<td>2 CR</td>
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<tr>
<td>T-MACH-107669</td>
<td>Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</td>
<td>2 CR</td>
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</table>

**Competence Certificate**

Written or oral exam

**Competence Goal**

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

The specific learning outcomes are defined by the respective coordinator of the course.

**Prerequisites**

None

**Content**

See chosen brick courses.

**Workload**

The workload is about 240 hours, corresponding to 8 credit points. The workload varies from lecture to lecture, for example a lecture consisting of 4 credit points includes 28 h of presence during the lecture and 92 h preparation and rework time at home, 120 hours in total.

**Learning type**

Lecture, Tutorial, Lab Course
9 MODULES

9.2 Module: Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering (MSc-Modul WPF-Modul NIE) [M-MACH-102595]

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

**Credits:** 6  
**Grading scale:** pass/fail  
**Recurrence:** Each term  
**Duration:** 1 term  
**Language:** German/English  
**Level:** 4  
**Version:** 4

**Election notes**  
One or two brick courses, with a total of at least 6 CR, must be successfully completed.

| Election block: Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering () |
|---------------------------------------------------|-----------------|---------------|
| T-CHEMBIO-100302 Applied Chemistry | 4 CR |  |
| T-MACH-108847 Applied Mathematics in Natural Science: Flows with chemical reactions  
*This item will not influence the grade calculation of this parent.* | 6 CR | Class |
| T-INFO-101363 Automated Visual Inspection and Image Processing | 6 CR | Beyerer |
| T-ETIT-101930 Medical Imaging Techniques I | 3 CR | Dössel |
| T-ETIT-101931 Medical Imaging Techniques II | 3 CR | Dössel |
| T-ETIT-101956 Bioelectric Signals | 3 CR | Loewe |
| T-ETIT-106492 Biomedical Measurement Techniques I | 3 CR | Nahm |
| T-ETIT-101929 Biomedical Measurement Techniques II | 3 CR | Dössel |
| T-CIWVT-103113 Biology for Engineers I | 5 CR | Syldatk |
| T-ETIT-101938 Communication Systems and Protocols | 5 CR | Becker, Becker |
| T-ETIT-101954 Electrical Machines and Power Electronics | 6 CR | Becker |
| T-CHEMBIO-100303 Introduction to Rheology | 6 CR |  |
| T-ETIT-101955 Fundamentals on High Frequency Techniques | 6 CR | Zwick |
| T-INFO-101377 Localization of Mobile Agents | 6 CR | Hanebeck |
| T-MACH-108845 Magnetohydrodynamics  
*This item will not influence the grade calculation of this parent.* | 6 CR | Bühler |
| T-ETIT-100694 Methods of Signal Processing  
*This item will not influence the grade calculation of this parent.* | 6 CR | Heizmann |
| T-INFO-102061 Mobile Computing and Internet of Things | 5 CR | Beigl |
| T-ETIT-101939 Photovoltaics  
*This item will not influence the grade calculation of this parent.* | 6 CR | Powalla |
| T-MACH-109084 Physical Basics of Laser Technology  
*This item will not influence the grade calculation of this parent.* | 6 CR | Schneider |
| T-ETIT-101932 Physiology and Anatomy for Engineers I | 3 CR | Nahm |
| T-ETIT-101933 Physiology and Anatomy for Engineers II | 3 CR | Nahm |
| T-ETIT-100711 Practical Aspects of Electrical Drives | 4 CR | Becker |
| T-ETIT-101911 Sensors | 3 CR | Menesklou |
| T-ETIT-109313 Signals and Systems  
*This item will not influence the grade calculation of this parent.* | 6 CR | Heizmann |
| T-MACH-108846 Stability: from Order to Chaos  
*This item will not influence the grade calculation of this parent.* | 6 CR | Class |
| T-ETIT-110788 Superconductors for Energy Applications | 5 CR | Grilli |

**Competence Certificate**

The success is monitored within the framework of academic achievements, it can vary according to the individually choice. The module is not graded, and remains not graded even after the choice of one or several graded brick courses.
Competence Goal
After completing the elective module "Wahlpflichtmodul" the attendants are able to extend their knowledge in the field of mechanical engineering in the disciplines natural sciences, electrical engineering or the informatics. The attendants are aware of typical approaches in fields, that differ sufficiently from mechanical engineering and know specific methods and fundamentals of these fields. Thus, the attendants are able to solve interdisciplinary problems by applying this knowledge and to adopt specialist skills by themselves later.

Prerequisites
none

Content
Please refer to the description of the listed brick courses.

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

Learning type
Lecture
Exercise course (depending on the course)
9.3 Module: Compulsory Elective Subject Economics/Law (MSc-Modul WPF-Modul WR) [M-MACH-102596]

**Responsible:** Prof. Dr.-Ing. Kai Furmans

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Advanced Engineering Fundamentals

<table>
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<th>Grading scale</th>
<th>Recurrence</th>
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<th>Language</th>
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<td>Each term</td>
<td>1 term</td>
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**Election block: Compulsory Elective Module Economics/Law (1 item)**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>T-MACH-110652</td>
<td>Human Factors Engineering II</td>
<td>4 CR</td>
<td>Deml</td>
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<tr>
<td>T-MACH-105231</td>
<td>Leadership and Management Development</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Ploch</td>
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<td>T-MACH-105440</td>
<td>Leadership and Conflict Management</td>
<td>4 CR</td>
<td>Hatzl</td>
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<td>T-INFO-110300</td>
<td>Public Law I &amp; II</td>
<td>6 CR</td>
<td>Eichenhofer</td>
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<td>T-MACH-102107</td>
<td>Quality Management</td>
<td>4 CR</td>
<td>Lanza</td>
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<tr>
<td>T-GEISTSOZ-110845</td>
<td>Technical and environmental historical perspectives on current innovation processes</td>
<td>4 CR</td>
<td>Popplow</td>
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</table>

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

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

**Prerequisites**
none

**Content**
see chosen brick course

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

**Learning type**
Lectures and practices; self-study
9.4 Module: Fundamentals and Methods of Automotive Engineering (MSc-WPfM-GuM-FzgT) [M-MACH-102739]

**Responsible:** Prof. Dr. Frank Gauterin

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Specialization / Specialization: Vehicle Technology (mandatory)

<table>
<thead>
<tr>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
<th>Level</th>
<th>Version</th>
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<td>Each term</td>
<td>2 terms</td>
<td>German/English</td>
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**Election block: Fundamentals and Methods of Automotive Engineering (2 Items)**

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<tr>
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<th>Course Description</th>
<th>CR</th>
<th>Instructor(s)</th>
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<tr>
<td>T-MACH-105518</td>
<td>Human Factors Engineering I</td>
<td>4 CR</td>
<td>Deml</td>
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<td>T-MACH-105212</td>
<td>CAE-Workshop</td>
<td>4 CR</td>
<td>Albers, Matthiesen</td>
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<tr>
<td>T-MACH-111193</td>
<td>Data Driven Engineering 1: Machine Learning for Dynamical Systems</td>
<td>4 CR</td>
<td>Bauer</td>
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<tr>
<td>T-MACH-100535</td>
<td>Introduction into Mechatronics</td>
<td>6 CR</td>
<td>Böhland, Reischl</td>
</tr>
<tr>
<td>T-MACH-105209</td>
<td>Introduction into the Multi-Body Dynamics</td>
<td>5 CR</td>
<td>Seemann</td>
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<td>T-ETIT-100534</td>
<td>Electrical Engineering for Business Engineers, Part II</td>
<td>5 CR</td>
<td>Menesklou</td>
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<td>T-MACH-102093</td>
<td>Fluid Power Systems</td>
<td>4 CR</td>
<td>Geimer, Pilt</td>
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<td>T-MACH-109919</td>
<td>Basics of Technical Logistics I</td>
<td>4 CR</td>
<td>Mittwollen, Oellerich</td>
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<tr>
<td>T-MACH-109920</td>
<td>Basics of Technical Logistics II</td>
<td>5 CR</td>
<td>Hochstein</td>
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<td>T-MACH-105213</td>
<td>Fundamentals of Combustion I</td>
<td>4 CR</td>
<td>Maas</td>
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<tr>
<td>T-MACH-105210</td>
<td>Machine Dynamics</td>
<td>5 CR</td>
<td>Proppe</td>
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<tr>
<td>T-MACH-105293</td>
<td>Mathematical Methods in Dynamics</td>
<td>6 CR</td>
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<td>T-MACH-105294</td>
<td>Mathematical Methods of Vibration Theory</td>
<td>6 CR</td>
<td>Seemann</td>
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<tr>
<td>T-MACH-105295</td>
<td>Mathematical Methods in Fluid Mechanics</td>
<td>6 CR</td>
<td>Frohnapfel</td>
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<tr>
<td>T-MACH-100300</td>
<td>Modelling and Simulation</td>
<td>5 CR</td>
<td>Gumbsch, Nestler</td>
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<tr>
<td>T-MACH-102152</td>
<td>Novel Actuators and Sensors</td>
<td>4 CR</td>
<td>Kohl, Sommer</td>
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<tr>
<td>T-MATH-102242</td>
<td>Numerical Mathematics for Students of Computer Science</td>
<td>6 CR</td>
<td>Rieder, Weiß, Wieners</td>
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<td>T-MACH-102102</td>
<td>Physical Basics of Laser Technology</td>
<td>5 CR</td>
<td>Schneider</td>
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<td>T-MACH-100530</td>
<td>Physics for Engineers</td>
<td>5 CR</td>
<td>Dienwiebel, Gumbsch, Nesterov-Müller, Weygand</td>
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<td>T-MACH-105147</td>
<td>Product Lifecycle Management</td>
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<td>T-MACH-100531</td>
<td>Systematic Materials Selection</td>
<td>4 CR</td>
<td>Dietrich, Schulze</td>
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<td>T-MACH-105652</td>
<td>Fundamentals of Combustion Engine Technology</td>
<td>5 CR</td>
<td>Bernhardt, Kubach, Pfeil, Toedter, Wagner</td>
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<td>T-MACH-102083</td>
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<td>T-MATH-109620</td>
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<td>T-MACH-105292</td>
<td>Heat and Mass Transfer</td>
<td>4 CR</td>
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<td>T-MACH-100532</td>
<td>Scientific Computing for Engineers</td>
<td>4 CR</td>
<td>Gumbsch, Weygand</td>
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**Competence Certificate**
2 individual exams: written or oral, graded

**Competence Goal**
"Fundamentals and Methods of Automotive Engineering" serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical engineering.

**Prerequisites**
None

**Content**
see chosen brick course
**Workload**
The work load is about 240 hours, corresponding to 8 credit points.

**Learning type**
Lecture, exercise.
Module: Fundamentals and Methods of Energy and Environmental Engineering (MSc-WPfM-GuM-E+U) [M-MACH-102575]

**M 9.5 Module: Fundamentals and Methods of Energy and Environmental Engineering (MSc-WPfM-GuM-E+U) [M-MACH-102575]**

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

**Part of:** Specialization / Specialization: Energy- and Environment Engineering (mandatory)

<table>
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**Mandatory**

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<td>Heat and Mass Transfer</td>
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**Election block: Fundamentals and Methods of Energy and Environmental Engineering (1 item)**

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<td>4 CR</td>
<td>Albers, Matthiesen</td>
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<tr>
<td>T-MACH-100535</td>
<td>Introduction into Mechatronics</td>
<td>6 CR</td>
<td>Böhland, Reischl</td>
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<tr>
<td>T-MACH-105209</td>
<td>Introduction into the Multi-Body Dynamics</td>
<td>5 CR</td>
<td>Seemann</td>
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<td>T-MACH-102093</td>
<td>Fluid Power Systems</td>
<td>4 CR</td>
<td>Geimer, Pult</td>
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<tr>
<td>T-MACH-109919</td>
<td>Basics of Technical Logistics I</td>
<td>4 CR</td>
<td>Mittwollen, Oellerich</td>
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<td>T-MACH-105213</td>
<td>Fundamentals of Combustion I</td>
<td>4 CR</td>
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<td>T-MACH-105210</td>
<td>Machine Dynamics</td>
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<td>6 CR</td>
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<td>Novel Actuators and Sensors</td>
<td>4 CR</td>
<td>Kohl, Sommer</td>
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<td>T-MATH-102242</td>
<td>Numerical Mathematics for Students of Computer Science</td>
<td>6 CR</td>
<td>Rieder, Weiß, Wieners</td>
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<td>T-MACH-100530</td>
<td>Physics for Engineers</td>
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<td>Dienwiebel, Gumbsch, Nesterov-Müller, Weygand</td>
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<td>Physical Basics of Laser Technology</td>
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<td>4 CR</td>
<td>Dietrich, Schulze</td>
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<td>T-MACH-105652</td>
<td>Fundamentals of Combustion Engine Technology</td>
<td>5 CR</td>
<td>Bernhardt, Kubach, Pfeil, Toedter, Wagner</td>
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<tr>
<td>T-MACH-105290</td>
<td>Vibration Theory</td>
<td>5 CR</td>
<td>Fidlin, Seemann</td>
</tr>
</tbody>
</table>

**Competence Certificate**

2 individual exams: written or oral, graded

**Competence Goal**

"Fundamentals and Methods of Energy and Environmental Engineering" serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical engineering.

**Prerequisites**

none

**Content**

see chosen brick course

**Workload**

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

**Learning type**

Lecture, exercise
Module: Fundamentals and Methods of General Mechanical Engineering (MSc-WPfM-GuM-MB) [M-MACH-102405]

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

Part of: Specialization / Specialization: General Mechanical Engineering (mandatory)

Credits: 8
Grading scale: Grade to a tenth
Recurrence: Each term
Duration: 2 terms
Language: German/English
Level: 4
Version: 3

Election block: Fundamentals and Methods of General Mechanical Engineering (2 items)

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<td>Human Factors Engineering I</td>
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<td>CAE-Workshop</td>
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<td>4 CR</td>
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<tr>
<td>T-MACH-100535</td>
<td>Introduction into Mechatronics</td>
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<td>Böhland, Reischl</td>
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<tr>
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Election block: Fundamentals and Methods of General Mechanical Engineering (Ü) ()

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T-MACH-110376 | Tutorial Mathematical Methods in Continuum Mechanics | 2       | 2 CR | Böhke             |

Competence Certificate
2 individual exams: written or oral, graded
Competence Goal
"Fundamentals and Methods of General Mechanical Engineering" serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical engineering.

Prerequisites
None.

Content
see chosen brick course

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

Learning type
Lecture, exercise
M 9.7 Module: Fundamentals and Methods of Materials and Structures for High Performance Systems (MSc-WPfPM-W+S) [M-MACH-102744]

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

**Part of:** Specialization / Specialization: Materials and Structures for High Performance Systems (mandatory)

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<td>Mittwollen, Oellerich</td>
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<td>Vibration Theory</td>
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**Election block:** Fundamentals and Methods of Materials and Structures for High Performance Systems (1 item)

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**Competence Certificate**

2 individual exams: written or oral, graded

**Competence Goal**

"Fundamentals and Methods of Materials and Structures for High Performance Systems" serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical engineering.

**Prerequisites**

none

**Content**

see chosen brick course

**Workload**

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

**Learning type**

Lecture, exercise.
### Module: Fundamentals and Methods of Mechatronics and Microsystem Technology (MSc-WPfM-M+M) [M-MACH-102740]

**Responsible:** Prof. Dr. Jan Gerrit Korvink  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Specialization / Specialization: Mechatronics and Microsystems Technology (mandatory)

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#### Election block: Fundamentals and Methods of Mechatronics and Microsystem Technology (1 item)

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#### Election block: Fundamentals and Methods of Mechatronics and Microsystem Technology (1 item)

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<td>5 CR</td>
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#### Competence Certificate

2 individual exams: written or oral, graded

#### Competence Goal

"Fundamentals and Methods of Mechatronics and Microsystem Technology" serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical engineering.

#### Prerequisites

None

#### Content

see chosen brick course

#### Workload

The work load is about 240 hours, corresponding to 8 credit points.
Learning type
Lecture, exercise
9.9 Module: Fundamentals and Methods of Product Development and Construction (MSc-WPfM-GuM-PEK) [M-MACH-102741]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Specialization / Specialization: Product Development and Engineering Design (mandatory)

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**Election block: Fundamentals and Methods of Product Development and Construction (2 items)**

- **T-MACH-105518** Human Factors Engineering I  
  4 CR Deml
- **T-MACH-105212** CAE-Workshop  
  4 CR Albers, Matthiesen
- **T-MACH-100535** Introduction into Mechatronics  
  6 CR Böhlke, Reischl
- **T-MACH-105209** Introduction into the Multi-Body Dynamics  
  5 CR Seemann
- **T-MACH-102093** Fluid Power Systems  
  4 CR Geimer, Pult
- **T-MACH-105182** Introduction to Microsystem Technology I  
  4 CR Badilita, Jouda, Korvink
- **T-MACH-105183** Introduction to Microsystem Technology II  
  4 CR Jouda, Korvink
- **T-MACH-109919** Basics of Technical Logistics I  
  4 CR Mittwollen, Oellerich
- **T-MACH-109920** Basics of Technical Logistics II  
  5 CR Hochstein
- **T-MACH-105210** Machine Dynamics  
  5 CR Proppe
- **T-MACH-105293** Mathematical Methods in Dynamics  
  6 CR Proppe
- **T-MACH-105294** Mathematical Methods of Vibration Theory  
  6 CR Seemann
- **T-MACH-105295** Mathematical Methods in Fluid Mechanics  
  6 CR Frohnapfel
- **T-MACH-105298** Mathematical Methods in Structural Mechanics  
  5 CR Böhlke
- **T-MACH-102152** Novel Actuators and Sensors  
  4 CR Kohl, Sommer
- **T-MACH-102102** Physical Basics of Laser Technology  
  5 CR Schneider
- **T-MACH-105147** Product Lifecycle Management  
  4 CR Ovtcharova
- **T-MACH-100531** Systematic Materials Selection  
  4 CR Dietrich, Schulze
- **T-MACH-105652** Fundamentals of Combustion Engine Technology  
  5 CR Bernhardt, Kubach, Pfeil, Toedter, Wagner
- **T-MACH-102083** Integrated Information Systems for Engineers  
  4 CR Ovtcharova
- **T-MACH-105290** Vibration Theory  
  5 CR Fidlin, Seemann
- **T-MACH-105292** Heat and Mass Transfer  
  4 CR Maas, Yu

**Election block: Fundamentals and Methods of Product Development and Construction (Ü) ()**

- **T-MACH-106831** Tutorial Mathematical Methods in Structural Mechanics  
  1 CR Böhlke  
  This item will not influence the grade calculation of this parent.

**Competence Certificate**

2 individual exams: written or oral, graded

**Competence Goal**

"Fundamentals and Methods of Product Development and Construction" serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical Engineering.

**Prerequisites**

None

**Content**

See brick courses.

**Workload**

The work load is about 240 hours, corresponding to 8 credit points.
Learning type
Lecture, exercise.
### 9.10 Module: Fundamentals and Methods of Production Technology (MSc-WPf-GuM-PT) [M-MACH-102742]

**Responsible:** Prof. Dr.-Ing. Volker Schulze  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Specialization / Specialization: Production Technology (mandatory)

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**Election block: Fundamentals and Methods of Production Technology (2 items)**

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<td>Geimer, Pult</td>
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<td>T-MACH-102102</td>
<td>Physical Basics of Laser Technology</td>
<td>5 CR</td>
<td>Schneider</td>
</tr>
<tr>
<td>T-MACH-105147</td>
<td>Product Lifecycle Management</td>
<td>4 CR</td>
<td>Ovtcharova</td>
</tr>
<tr>
<td>T-MACH-100531</td>
<td>Systematic Materials Selection</td>
<td>4 CR</td>
<td>Dietrich, Schulze</td>
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<tr>
<td>T-MACH-102083</td>
<td>Integrated Information Systems for Engineers</td>
<td>4 CR</td>
<td>Ovtcharova</td>
</tr>
<tr>
<td>T-MACH-105290</td>
<td>Vibration Theory</td>
<td>5 CR</td>
<td>Fidlin, Seemann</td>
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</table>

**Election block: Fundamentals and Methods of Production Technology (Ü) ()**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Instructor(s)</th>
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<tbody>
<tr>
<td>T-MACH-110376</td>
<td>Tutorial Mathematical Methods in Continuum Mechanics</td>
<td>2 CR</td>
<td>Böhlke</td>
</tr>
</tbody>
</table>

**Competence Certificate**

2 exams:

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

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

**Competence Goal**

"Fundamentals and Methods of Production Technology" serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical engineering

**Prerequisites**

none

**Content**

Fundamentals and Methods of Production Technology

**Workload**

The work load is about 240 hours, corresponding to 8 credit points.
Learning type
Lectures, seminars, workshops, excursions
### 9.11 Module: Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering (MSc-WPfM-GuM-ThM) [M-MACH-102743]

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

**Part of:** Specialization / Specialization: Theoretical Mechanical Engineering (mandatory)

<table>
<thead>
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<th>Duration</th>
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#### Election block: Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering (2 items)

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<tr>
<td>T-MACH-109302</td>
<td>Computational Homogenization on Digital Image Data</td>
<td>6 CR</td>
<td>Schneider</td>
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<tr>
<td>T-MACH-110431</td>
<td>Digital microstructure characterization and modeling</td>
<td>6 CR</td>
<td>Schneider</td>
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<tr>
<td>T-MACH-105209</td>
<td>Introduction into the Multi-Body Dynamics</td>
<td>5 CR</td>
<td>Seemann</td>
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<td>T-MACH-102093</td>
<td>Fluid Power Systems</td>
<td>4 CR</td>
<td>Geimer, Pult</td>
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<tr>
<td>T-MACH-105213</td>
<td>Fundamentals of Combustion I</td>
<td>4 CR</td>
<td>Maas</td>
</tr>
<tr>
<td>T-MACH-110377</td>
<td>Continuum Mechanics of Solids and Fluids</td>
<td>3 CR</td>
<td>Böhlke, Frohnapfel</td>
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<td>T-MACH-105210</td>
<td>Machine Dynamics</td>
<td>5 CR</td>
<td>Proppe</td>
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<td>T-MACH-105293</td>
<td>Mathematical Methods in Dynamics</td>
<td>6 CR</td>
<td>Proppe</td>
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<td>T-MACH-110375</td>
<td>Mathematical Methods in Continuum Mechanics</td>
<td>4 CR</td>
<td>Böhlke</td>
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<td>T-MACH-105294</td>
<td>Mathematical Methods of Vibration Theory</td>
<td>6 CR</td>
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<td>T-MACH-105295</td>
<td>Mathematical Methods in Fluid Mechanics</td>
<td>6 CR</td>
<td>Frohnapfel</td>
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<tr>
<td>T-MACH-105189</td>
<td>Mathematical Models and Methods for Production Systems</td>
<td>6 CR</td>
<td>Baumann, Furmans</td>
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<tr>
<td>T-MACH-105396</td>
<td>Modeling of Thermodynamical Processes</td>
<td>6 CR</td>
<td>Maas, Schießl</td>
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<td>T-MACH-105303</td>
<td>Modelling of Microstructures</td>
<td>5 CR</td>
<td>August, Nestler</td>
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<td>T-MACH-100300</td>
<td>Modelling and Simulation</td>
<td>5 CR</td>
<td>Gumbsch, Nestler</td>
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<td>T-MACH-110380</td>
<td>Nonlinear optimization methods</td>
<td>6 CR</td>
<td>Schneider</td>
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<td>T-MACH-111026</td>
<td>Nonlinear Continuum Mechanics</td>
<td>3 CR</td>
<td>Böhlke</td>
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<tr>
<td>T-MACH-111023</td>
<td>Numerical Solution of Nonlinear Equations</td>
<td>6 CR</td>
<td>Schneider</td>
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<td>T-MATH-102242</td>
<td>Numerical Mathematics for Students of Computer Science</td>
<td>6 CR</td>
<td>Rieder, Weiß, Wiener</td>
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<td>T-MACH-100530</td>
<td>Physics for Engineers</td>
<td>5 CR</td>
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<td>T-MACH-100531</td>
<td>Systematic Materials Selection</td>
<td>4 CR</td>
<td>Dietrich, Schulze</td>
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<td>T-MACH-105290</td>
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<td>Fidlin, Seemann</td>
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<td>T-MATH-109620</td>
<td>Probability Theory and Statistics</td>
<td>6 CR</td>
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<td>T-MACH-105292</td>
<td>Heat and Mass Transfer</td>
<td>4 CR</td>
<td>Maas, Yu</td>
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<tr>
<td>T-MACH-100532</td>
<td>Scientific Computing for Engineers</td>
<td>4 CR</td>
<td>Gumbsch, Weygand</td>
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#### Election block: Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering (Ü) ()

<table>
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<tr>
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<tr>
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<td>Tutorial Nonlinear Continuum Mechanics</td>
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<td>T-MACH-110333</td>
<td>Tutorial Continuum Mechanics of Solids and Fluids</td>
<td>1 CR</td>
<td>Böhlke, Frohnapfel</td>
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<tr>
<td>T-MACH-110376</td>
<td>Tutorial Mathematical Methods in Continuum Mechanics</td>
<td>2 CR</td>
<td>Böhlke</td>
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<tr>
<td>T-MACH-110379</td>
<td>Tutorial Mathematical Methods in Micromechanics</td>
<td>1 CR</td>
<td>Böhlke</td>
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</table>

**Competence Certificate**

2 individual exams: written or oral, graded

**Competence Goal**

"Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering" serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical engineering.

**Prerequisites**

None
Content
see chosen course

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

Learning type
Lecture, tutorial
9.12 Module: Key Competences [M-MACH-102824]

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

Part of: Advanced Engineering Fundamentals

Election notes
Interdisciplinary qualifications (IQ) completed at the House of Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaft und Studium Generale (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”.

Election block: Key Competences (1 Item)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
<th>Level</th>
<th>Version</th>
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<tr>
<td>T-MACH-105721</td>
<td>Engineer's Field of Work</td>
<td>2 CR</td>
<td>pass/fail</td>
<td>Each term</td>
<td>1 term</td>
<td>English</td>
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<tr>
<td>T-MACH-106700</td>
<td>Do it! – Service-Learning for prospective mechanical engineers</td>
<td>2 CR</td>
<td>pass/fail</td>
<td>Each term</td>
<td>1 term</td>
<td>German</td>
<td>4</td>
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<td>T-MACH-110961</td>
<td>Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example</td>
<td>2 CR</td>
<td>pass/fail</td>
<td>Each term</td>
<td>1 term</td>
<td>German</td>
<td>4</td>
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<tr>
<td>T-MACH-111686</td>
<td>Self-Booking-MSc-HOC-SPZ-ZAK-Non-Graded</td>
<td>2 CR</td>
<td>pass/fail</td>
<td>Each term</td>
<td>1 term</td>
<td>German</td>
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<td>T-MACH-111687</td>
<td>Self-Booking-MSc-HOC-SPZ-ZAK-Graded</td>
<td>2 CR</td>
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<td>Each term</td>
<td>1 term</td>
<td>German</td>
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</table>

Competence Certificate
Success is monitored within the framework of academic achievements.
Amount, type and scope of the success control can vary according to the individually choice.

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.

Module grade calculation
Certification without grade

Prerequisites
none

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

Annotation
Only HoC/SPZ/ZAK courses and courses from the "Compulsory-elective block Key Competences" can be chosen.
Workload
The work load is about 60 hours (thereof an attendance time of about 28 hours), corresponding to 2 credit points in the Master of Science program.

Learning type
lectures, seminars, tutorials, lab courses.
**9.13 Module: Laboratory Course (MSc-Modul 07, FP) [M-MACH-102591]**

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Advanced Engineering Fundamentals

<table>
<thead>
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<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
<th>Level</th>
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<td>4</td>
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<td>Each term</td>
<td>1 term</td>
<td>German/English</td>
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**Election block: Specialized Practical Training (1 item)**

<table>
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<th>Course Name</th>
<th>Credits</th>
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<tr>
<td>T-MACH-105230</td>
<td>Decently Controlled Intralogistic Systems</td>
<td>4 CR</td>
<td>Furmans, Hochstein</td>
</tr>
<tr>
<td>T-MACH-105447</td>
<td>Metallographic Lab Class</td>
<td>4 CR</td>
<td>Heilmaier, Mühl</td>
</tr>
<tr>
<td>T-MACH-105222</td>
<td>Motor Vehicle Labor</td>
<td>4 CR</td>
<td>Frey</td>
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<tr>
<td>T-MACH-108312</td>
<td>Introduction to Microsystem Technology - Practical Course</td>
<td>4 CR</td>
<td>Last</td>
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<tr>
<td>T-MACH-105331</td>
<td>Laboratory Exercise in Energy Technology</td>
<td>4 CR</td>
<td>Bauer, Maas, Wirbser</td>
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<tr>
<td>T-MACH-105370</td>
<td>Laboratory Mechatronics</td>
<td>4 CR</td>
<td>Hagenmeyer, Seemann, Stiller</td>
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<tr>
<td>T-MACH-105300</td>
<td>Measurement Instrumentation Lab</td>
<td>4 CR</td>
<td>Richter, Stiller</td>
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<tr>
<td>T-MACH-105337</td>
<td>Engine Laboratory</td>
<td>4 CR</td>
<td>Wagner</td>
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<tr>
<td>T-MACH-106693</td>
<td>Plug-and-Play Material Handling</td>
<td>4 CR</td>
<td>Auberle, Furmans</td>
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<tr>
<td>T-MACH-106707</td>
<td>Workshop on Computer-based Flow Measurement Techniques</td>
<td>4 CR</td>
<td>Bauer</td>
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<td>T-MACH-102154</td>
<td>Laboratory Laser Materials Processing</td>
<td>4 CR</td>
<td>Schneider</td>
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<td>T-MACH-105343</td>
<td>Lab Course Experimental Solid Mechanics</td>
<td>4 CR</td>
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<td>T-MACH-108878</td>
<td>Laboratory Production Metrology</td>
<td>4 CR</td>
<td>Häfner</td>
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<td>Practical Course “Tribology”</td>
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<td>Production Techniques Laboratory</td>
<td>4 CR</td>
<td>Deml, Fleischer, Furmans, Ovtcharova</td>
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<tr>
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<td>Project Internship Additive Manufacturing: Development and Production of an Additive Component</td>
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<td>T-MACH-106738</td>
<td>ProVIL - Product Development in a Virtual Idea Laboratory</td>
<td>4 CR</td>
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<td>T-MACH-105373</td>
<td>Practical Training in Measurement of Vibrations</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-108796</td>
<td>Flow Measurement Techniques</td>
<td>4 CR</td>
<td>Kriegseis</td>
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</table>

**Competence Certificate**

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

**Competence Goal**

Students are able to:

- Model typical problems in the laboratory and use typical methods of mechanical science to inquire,
- Built experiment designs, while choosing appropriate system components and models,
- Accomplish experiments goal-oriented,
- Analyse and evaluate results of experiments.
Prerequisites
none

Content
see chosen practical training

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

Learning type
practical training, self-study
9.14 Module: Major Field: Advanced Materials Modelling (SP 56) [M-MACH-102649]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Specialization / Specialization: General Mechanical Engineering (Major Fields)
Specialization / Specialization: Theoretical Mechanical Engineering (Major Field)
Specialization / Specialization: Materials and Structures for High Performance Systems (Major Field)

<table>
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**Mandatory**

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<tr>
<td>T-MACH-111537</td>
<td>Mathematical Methods in Micro Mechanics</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-111588</td>
<td>Data Science and Scientific Workflows</td>
<td>3 CR</td>
<td>Gumbsch, Weygand</td>
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**Election block: Advanced Materials Modelling and Data Management (E) ()**

<table>
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<td>Atomistic Simulations and Molecular Dynamics</td>
<td>4 CR</td>
<td>Gumbsch, Schneider, Weygand</td>
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<tr>
<td>T-MACH-105459</td>
<td>High Temperature Materials</td>
<td>4 CR</td>
<td>Heilmaier</td>
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<td>T-MACH-105554</td>
<td>Thin Film and Small-scale Mechanical Behavior</td>
<td>4 CR</td>
<td>Gruber, Kirchlechner, Weygand</td>
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<td>T-MACH-110957</td>
<td>Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement</td>
<td>4 CR</td>
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**Election block: Advanced Materials Modelling and Data Management (Ü) ()**

<table>
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<tbody>
<tr>
<td>T-MACH-111603</td>
<td>Data Science and Scientific Workflows (Project)</td>
<td>1 CR</td>
<td>Gumbsch, Weygand</td>
</tr>
</tbody>
</table>

**Competence Certificate**

Oral exams: duration approx. 5 min. per credit point.

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

**Competence Goal**

After having finished this major field the students can

- list important concepts and models for describing material behaviour
- map different material models or concepts to different length scales
- understand concepts of data management, digital workflows and digital infrastructure

**Prerequisites**

None

**Content**

The comprehensive topic of the major field is the knowledge of basic scientific methods and concepts for describing the material behaviour of applied materials considering their microstructure. Hereby, methods of data management and digital workflows are combined with concepts of material modelling and microstructure description within a unified approach. Together with standardization processes synergies and increase of efficiency for cooperation of scientists can be realized.

The precise topics refer to the fields of mechanics, computational material science and material science.

**Annotation**

none

**Workload**

The work load is about 480 hours in the Master of Science program, whereof the presence time is 100 h

**Learning type**

Lectures, Tutorials, consultation hours
9.15 Module: Major Field: Advanced Mechatronics (SP 01) [M-MACH-102598]

Responsible: apl. Prof. Dr. Markus Reischl
Organisation: KIT Department of Mechanical Engineering

Part of:
- Specialization / Specialization: General Mechanical Engineering (Major Fields)
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)
- Specialization / Specialization: Vehicle Technology (Major Field)
- Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field (p))
- Specialization / Specialization: Product Development and Engineering Design (Major Field)
- Specialization / Specialization: Production Technology (Major Field)
- Specialization / Specialization: Theoretical Mechanical Engineering (Major Field)

Credits 16
Grading scale Grade to a tenth
Recurrence Each term
Duration 2 terms
Language German/English
Level 4
Version 5

Election notes
In the core area of each Major Field at least 8 ECTS have to be chosen.

**Election block: Advanced Mechatronics (K) (at least 8 credits)**

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<th>Course Title</th>
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<td>Data Analytics for Engineers</td>
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<td>T-MACH-100535</td>
<td>Introduction into Mechatronics</td>
<td>6 CR</td>
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<tr>
<td>T-MACH-105335</td>
<td>Measurement II</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105384</td>
<td>Computerized Multibody Dynamics</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105443</td>
<td>Wave Propagation</td>
<td>4 CR</td>
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**Election block: Advanced Mechatronics (E) (at most 9 credits)**

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<th>Credits</th>
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<td>Actuators and Sensors in Nanotechnology</td>
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<td>T-MACH-100844</td>
<td>Automated Manufacturing Systems</td>
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<td>BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I</td>
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<td>BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II</td>
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<td>T-MACH-105314</td>
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<td>Data Driven Engineering 1: Machine Learning for Dynamical Systems</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-111373</td>
<td>Data Driven Engineering 2: Advanced Topics</td>
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<td>Digital Control</td>
<td>4 CR</td>
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<td>T-MACH-111260</td>
<td>Dynamics of Electro-Mechanical Systems</td>
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<td>Introduction into the Multi-Body Dynamics</td>
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<td>Experimental Dynamics</td>
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<td>T-MACH-105156</td>
<td>Vehicle Mechatronics I</td>
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<td>T-MACH-105218</td>
<td>Automotive Vision</td>
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<td>T-MACH-105187</td>
<td>IT-Fundamentals of Logistics</td>
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<td>Cognitive Automobiles - Laboratory</td>
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<td>T-MACH-105223</td>
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<td>T-MACH-105294</td>
<td>Mathematical Methods of Vibration Theory</td>
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<td>Mechanics in Microtechnology</td>
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<td>T-INFO-101266</td>
<td>Human-Machine-Interaction</td>
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Data: Meisenbacher, Mikut, Reischl
Böhland, Reischl
Stiller
Seemann
Kohl
Fleischer
Guber
Albers, Matthiesen
Mikut, Reinartz, Reischl
Bauer
Knoop
Fidlin
Seemann
Ammon
Lauer, Stiller
Thomas
Kitt, Lauer, Stiller
Albers, Burkardt
Lauer, Stiller
Propp
Seemann
Greiner, Gruber
Beigl
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<td>T-MACH-105372</td>
<td>Theory of Stability</td>
<td>6 CR</td>
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<td>System Integration in Micro- and Nanotechnology</td>
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<td>Vibration Theory</td>
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<tr>
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**Election block: Advanced Mechatronics (I) (at most 4 credits)**

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**Election block: Advanced Mechatronics (Ü) ()**

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<tbody>
<tr>
<td>T-INFO-106257</td>
<td>Human-Machine-Interaction Pass</td>
<td>0 CR</td>
<td>Beigl</td>
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</table>

**Competence Certificate**

Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**

Students of the major Advanced Mechatronics know the future-oriented procedures. They are able to creatively solve complex interdisciplinary questions, in particular by applying the latest computer-assisted mathematical methods.

**Prerequisites**

None

**Content**

The Advanced Mechatronics offers a broad, multidisciplinary body of knowledge. It qualifies graduates to solve essential mechatronic questions. In particular the following disciplines are covered by the major Advanced Mechatronics:

- Control theory
- measurement technology and signal processing,
- modelling and
- mathematical methods.

**Workload**

The work load is about 480 hours, corresponding to 16 credit points.

**Learning type**

The contents of this major field are taught in form of lectures, exercises and practical experiences.
9.16 Module: Major Field: Applied Mechanics (SP 30) [M-MACH-102646]

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

Part of: Specialization / Specialization: General Mechanical Engineering (Major Fields)
Specialization / Specialization: Energy- and Environment Engineering (Major Field)
Specialization / Specialization: Vehicle Technology (Major Field)
Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)
Specialization / Specialization: Product Development and Engineering Design (Major Field)
Specialization / Specialization: Theoretical Mechanical Engineering (Major Field (p))
Specialization / Specialization: Materials and Structures for High Performance Systems (Major Field)

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

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

**Election block: Applied Mechanics (K) (at least 8 credits)**

<table>
<thead>
<tr>
<th>Course Code</th>
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**Election block: Applied Mechanics (E) (at most 1 item)**

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<tr>
<td>T-MACH-105321</td>
<td>Introduction to Theory of Materials</td>
<td>4 CR</td>
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<td>T-MACH-105439</td>
<td>Introduction to Nonlinear Vibrations</td>
<td>7 CR</td>
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<td>Foundations of Nonlinear Continuum Mechanics</td>
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<td>T-MACH-105349</td>
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<td>T-MACH-105970</td>
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<tr>
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<td>Fidlin, Seemann</td>
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<tr>
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**Election block: Applied Mechanics (Ü) ()**

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<td>Tutorial Mathematical Methods in Micromechanics</td>
<td>1 CR</td>
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</table>

**Competence Certificate**

Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.
Competence Goal
After having finished this major field the students can

- list important mathematical concepts that are applied in mechanics
- analyze, evaluate and assess models of mechanics according to their mathematical structure
- apply mathematical algorithms for solving special problems in mechanics
- select a mathematical description of a given problem in mechanics

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials, consultation hours
9 MODULES

9.17 Module: Major Field: Automation Technology (SP 04) [M-MACH-102601]

Responsible: apl. Prof. Dr. Ralf Mikut
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Major Fields)
Specialization / Specialization: Energy- and Environment Engineering (Major Field)
Specialization / Specialization: Vehicle Technology (Major Field)
Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field (p))
Specialization / Specialization: Product Development and Engineering Design (Major Field)
Specialization / Specialization: Production Technology (Major Field)
Specialization / Specialization: Theoretical Mechanical Engineering (Major Field)

Credits 16
Grading scale Grade to a tenth
Recurrence Each term
Duration 2 terms
Language German/English
Level 4
Version 4

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

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<th>Election block: Automation Technology (K) (at least 8 credits)</th>
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<tbody>
<tr>
<td>T-MACH-105314 Computational Intelligence 4 CR Mikut, Reinartz, Reischl</td>
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<tr>
<td>T-MACH-105694 Data Analytics for Engineers 5 CR Meisenbacher, Mikut, Reischl</td>
</tr>
<tr>
<td>T-MACH-105317 Digital Control 4 CR Knoop</td>
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<td>T-MACH-100535 Introduction into Mechatronics 6 CR Böhland, Reischl</td>
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<td>T-MACH-105156 Vehicle Mechatronics I 4 CR Ammon</td>
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<td>T-MACH-105335 Measurement II 4 CR Stiller</td>
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<td>T-MACH-110272 System Integration in Micro- and Nanotechnology 2 4 CR Gengenbach</td>
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<td>T-MACH-105443 Wave Propagation 4 CR Seemann</td>
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<td>T-MACH-102149 Virtual Reality Practical Course 4 CR Ovtcharova</td>
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Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.
**Competence Goal**
The Automation Engineering offers both theoretical foundations and practical knowledge in the field of automation. Students can select, apply and enhance existing methods. The main focus of the major is on

- Applied control engineering
- Automation
- Examples of field applications

Students of Automation Engineering are qualified to master complex challenges of the future. They are able to apply their profound knowledge and the future-oriented methods independent of a particular application field.

**Prerequisites**
None

**Content**
See brick courses.

**Workload**
The work load is about 480 hours, corresponding to 16 credit points.

**Learning type**
Lectures, Tutorials
### Module: Major Field: Cognitive Technical Systems (SP 22) [M-MACH-102609]

**Responsible:** Prof. Dr.-Ing. Christoph Stiller  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- Specialization / Specialization: General Mechanical Engineering (Major Fields)  
- Specialization / Specialization: Vehicle Technology (Major Field)  
- Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)  
- Specialization / Specialization: Product Development and Engineering Design (Major Field)  
- Specialization / Specialization: Production Technology (Major Field)  
- Specialization / Specialization: Theoretical Mechanical Engineering (Major Field)

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<tr>
<th>Credits</th>
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<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
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<td>16</td>
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<td>2 terms</td>
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**Election notes**  
In the core area of Major Field at least 8 ECTS have to be chosen.

#### Election block: Cognitive Technical Systems (K) (at least 8 credits)

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<td>Automotive Vision</td>
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<td>Lauer, Stiller</td>
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<td>T-MACH-105367</td>
<td>Behaviour Generation for Vehicles</td>
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<td>Naumann, Werling</td>
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#### Election block: Cognitive Technical Systems (E) (at most 8 credits)

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<td>Data Driven Engineering 1: Machine Learning for Dynamical Systems</td>
<td>4</td>
<td>Bauer</td>
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<td>Data Driven Engineering 2: Advanced Topics</td>
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<td>Digital Control</td>
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<td>T-INFO-101466</td>
<td>Information Processing in Sensor Networks</td>
<td>6</td>
<td>Hanebeck</td>
</tr>
<tr>
<td>T-MACH-105378</td>
<td>Cognitive Automobiles - Laboratory</td>
<td>6</td>
<td>Kitt, Lauer, Stiller</td>
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<tr>
<td>T-INFO-101356</td>
<td>Cognitive Systems</td>
<td>6</td>
<td>Neumann, Waibel</td>
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<td>T-INFO-101377</td>
<td>Localization of Mobile Agents</td>
<td>6</td>
<td>Hanebeck</td>
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<tr>
<td>T-MACH-105223</td>
<td>Machine Vision</td>
<td>8</td>
<td>Lauer, Stiller</td>
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<tr>
<td>T-MACH-105335</td>
<td>Measurement II</td>
<td>4</td>
<td>Stiller</td>
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<tr>
<td>T-MACH-105350</td>
<td>Computational Vehicle Dynamics</td>
<td>4</td>
<td>Proppe</td>
</tr>
<tr>
<td>T-INFO-108014</td>
<td>Robotics I - Introduction to Robotics</td>
<td>6</td>
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<td>T-INFO-101352</td>
<td>Robotics III - Sensors in Robotics</td>
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#### Election block: Cognitive Technical Systems (P) (at most 4 credits)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>CR</th>
<th>Tutors</th>
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<tbody>
<tr>
<td>T-MACH-105370</td>
<td>Laborotary Mechatronics</td>
<td>4</td>
<td>Hagemeyer, Seemann, Stiller</td>
</tr>
<tr>
<td>T-MACH-105341</td>
<td>Lab Computer-Aided Methods for Measurement and Control</td>
<td>4</td>
<td>Stiller</td>
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</tbody>
</table>

**Competition Certificate**  
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.
Competence Goal
Students are able to

- explain fundamental components and processing steps of cognitive technical systems
- explain the interplay of individual components and the flow of information between them
- outline the major properties of cognitive functions at examples in emerging applications like vehicular technology or robotics
- determine the level of system function and safety for cognitive technical systems

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials
## 9.19 Module: Major Field: Combustion Engines Based Powertrains (SP 58) [M-MACH-102650]

### Responsible:
Prof. Dr. Thomas Koch

### Organisation:
KIT Department of Mechanical Engineering

### Part of:
- Specialization / Specialization: General Mechanical Engineering (Major Fields)
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)
- Specialization / Specialization: Vehicle Technology (Major Field (p))
- Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)
- Specialization / Specialization: Product Development and Engineering Design (Major Field)

### Credits: 16
Grading scale: Grade to a tenth
Recurrence: Each term
Duration: 2 terms
Language: German/English
Level: 4
Version: 5

### Mandatory

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>T-MACH-111550</td>
<td>CO2-Neutral Combustion Engines and their Fuels I</td>
<td>4 CR</td>
<td>Koch</td>
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<tr>
<td>T-MACH-111585</td>
<td>Hydrogen and reFuels - Energy Conversion in Combustion Engines</td>
<td>4 CR</td>
<td>Kubach</td>
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### Election block: Combustion engines based powertrains (E1) ()

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<thead>
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<tbody>
<tr>
<td>T-MACH-105044</td>
<td>Fundamentals of Catalytic Exhaust Gas Aftertreatment</td>
<td>4 CR</td>
<td>Deutschmann, Grunwaldt, Kubach, Lox</td>
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<tr>
<td>T-MACH-105167</td>
<td>Analysis Tools for Combustion Diagnostics</td>
<td>4 CR</td>
<td>Pfeil</td>
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<tr>
<td>T-MACH-105169</td>
<td>Engine Measurement Techniques</td>
<td>4 CR</td>
<td>Bernhardt</td>
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<tr>
<td>T-MACH-104609</td>
<td>Combustion Engines II</td>
<td>5 CR</td>
<td>Koch, Kubach</td>
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### Election block: Combustion engines based powertrains (E2) ()

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>T-MACH-105173</td>
<td>Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines</td>
<td>4 CR</td>
<td>Gohl</td>
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<tr>
<td>T-MACH-110817</td>
<td>Development of hybrid drivetrains</td>
<td>4 CR</td>
<td>Koch</td>
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<tr>
<td>T-MACH-110818</td>
<td>Großdiesel- und -gasmotoren für Schiffsantriebe</td>
<td>4 CR</td>
<td>Kubach</td>
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<tr>
<td>T-MACH-105985</td>
<td>Ignition Systems</td>
<td>4 CR</td>
<td>Toedter</td>
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<tr>
<td>T-MACH-105310</td>
<td>Design of Highly Stresses Components</td>
<td>4 CR</td>
<td>Aktaa</td>
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<td>T-MACH-108844</td>
<td>Automated Manufacturing Systems</td>
<td>8 CR</td>
<td>Fleischer</td>
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<tr>
<td>T-MACH-105154</td>
<td>Vehicle Comfort and Acoustics I</td>
<td>4 CR</td>
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<td>T-MACH-105155</td>
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<td>T-MACH-105533</td>
<td>Gasdynamics</td>
<td>4 CR</td>
<td>Magagnato</td>
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<tr>
<td>T-MACH-100092</td>
<td>Automotive Engineering I</td>
<td>8 CR</td>
<td>Gauterin, Unrau</td>
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<tr>
<td>T-MACH-102117</td>
<td>Automotive Engineering II</td>
<td>4 CR</td>
<td>Gauterin, Unrau</td>
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<tr>
<td>T-MACH-105325</td>
<td>Fundamentals of Combustion II</td>
<td>4 CR</td>
<td>Bykov, Maas</td>
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<tr>
<td>T-MACH-105210</td>
<td>Machine Dynamics</td>
<td>5 CR</td>
<td>Proppe</td>
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<tr>
<td>T-MACH-105224</td>
<td>Machine Dynamics II</td>
<td>4 CR</td>
<td>Proppe</td>
</tr>
<tr>
<td>T-MACH-105442</td>
<td>Intellectual Property Rights and Strategies in Industrial Companies</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Zacharias</td>
</tr>
<tr>
<td>T-MACH-105347</td>
<td>Project Management in Global Product Engineering Structures</td>
<td>4 CR</td>
<td>Albers, Gutzmer, Matthiesen</td>
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<tr>
<td>T-MACH-105358</td>
<td>Sustainable Product Engineering</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Ziegahn</td>
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<tr>
<td>T-MACH-105531</td>
<td>Tribology</td>
<td>8 CR</td>
<td>Dienwiebel, Scherge</td>
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<tr>
<td>T-MACH-102148</td>
<td>Gear Cutting Technology</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-111560</td>
<td>CO2-Neutral Combustion Engines and their Fuels II</td>
<td>5 CR</td>
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<tr>
<td>T-MACH-111578</td>
<td>Sustainable Vehicle Drivetrains</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105337</td>
<td>Engine Laboratory</td>
<td>4 CR</td>
<td>Wagner</td>
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<tr>
<td>T-MACH-105169</td>
<td>Engine Measurement Techniques</td>
<td>4 CR</td>
<td>Bernhardt</td>
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<tr>
<td>T-MACH-105167</td>
<td>Analysis Tools for Combustion Diagnostics</td>
<td>4 CR</td>
<td>Pfeil</td>
</tr>
<tr>
<td>T-MACH-111591</td>
<td>Turbo Charging of Internal Combustion Engines</td>
<td>4 CR</td>
<td>Kech, Kubach</td>
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</tbody>
</table>
## Competence Certificate

Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

## Competence Goal

After completion of SP 58 students are able to:

- transfer fundamentals of thermodynamics and technical combustion to applications of combustion engines
- name and describe applications
- describe and explain the working principle of combustion engine and its application in vehicles
- analyze and evaluate propulsion systems

## Prerequisites

None

## Content

Energy converting machines are a key issue of technical engineering. Design and working principle are subject of the core area of SP 58. Fundamentals of thermodynamics are transferred to the application of internal combustion engines. In the supplementary area Measurement techniques to analyze and develop combustion engines as well as Fuels, Lubes and special engine concepts are addressed. The application of engines in drivetrains and production processes are continuative topics.

## Workload

The work load is about 480 hours, corresponding to 16 credit points.

## Learning type

Lecture, tutorial.
## 9.20 Module: Major Field: Computational Mechanics (SP 06) [M-MACH-102604]

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

### Credits
- **16**

### Grading scale
- Grade to a tenth

### Recurrence
- Each term

### Duration
- 2 terms

### Language
- German/English

### Level
- 4

### Version
- 1

### Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

#### Election block: Computational Mechanics (K) (at least 8 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Grader(s)</th>
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<tr>
<td>T-MACH-105338</td>
<td>Numerical Fluid Mechanics</td>
<td>4 CR</td>
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<td>T-MACH-105349</td>
<td>Computational Dynamics</td>
<td>4 CR</td>
<td>Proppe</td>
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<tr>
<td>T-MACH-105351</td>
<td>Computational Mechanics I</td>
<td>6 CR</td>
<td>Böhike, Langhoff</td>
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#### Election block: Computational Mechanics (E) (at most 8 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<th>Grader(s)</th>
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<tbody>
<tr>
<td>T-MACH-105390</td>
<td>Application of Advanced Programming Languages in Mechanical Engineering</td>
<td>4 CR</td>
<td>Weygand</td>
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<tr>
<td>T-MACH-105308</td>
<td>Atomistic Simulations and Molecular Dynamics</td>
<td>4 CR</td>
<td>Gumbsch, Schneider, Weygand</td>
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<tr>
<td>T-MACH-105391</td>
<td>Finite Difference Methods for Numerical Solution of Thermal and Fluid Dynamical Problems</td>
<td>4 CR</td>
<td>Günther</td>
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<tr>
<td>T-MACH-105394</td>
<td>Finite Volume Methods for Fluid Flow</td>
<td>4 CR</td>
<td>Günther</td>
</tr>
<tr>
<td>T-MACH-105396</td>
<td>Modeling of Thermodynamical Processes</td>
<td>6 CR</td>
<td>Maas, Schießl</td>
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<tr>
<td>T-MACH-105420</td>
<td>Numerical Simulation of Multi-Phase Flows</td>
<td>4 CR</td>
<td>Wörner</td>
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<tr>
<td>T-MACH-105339</td>
<td>Numerical Simulation of Reacting Two Phase Flows</td>
<td>4 CR</td>
<td>Koch</td>
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<tr>
<td>T-MACH-105397</td>
<td>Numerical Simulation of Turbulent Flows</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105350</td>
<td>Computational Vehicle Dynamics</td>
<td>4 CR</td>
<td>Proppe</td>
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<tr>
<td>T-MACH-105352</td>
<td>Computational Mechanics II</td>
<td>6 CR</td>
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#### Election block: Computational Mechanics (P) (at most 4 credits)

<table>
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<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Grader(s)</th>
</tr>
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<tbody>
<tr>
<td>T-MACH-105392</td>
<td>FEM Workshop - Constitutive Laws</td>
<td>4 CR</td>
<td>Schulz, Weygand</td>
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</table>

**Competence Certificate**  
Oral exams; duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**  
The module offers a wide interdisciplinary education of the students in the areas which are summarized internationally under the concept 'Computational Mechanics':

* Continuum modelling (in structural mechanics, material theory, dynamics, fluid mechanics and thermodynamics)  
* Numerical mathematics  
* Informatics

Students know the procedures oriented to the future of modern engineering. They have the ability for individual, creative solutions of complicated problems with numerical means and take into account the interaction with neighboring fields.

**Prerequisites**  
None

**Content**  
See brick courses.
Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials
Module: Major Field: Development of Innovative Appliances and Power Tools (SP 51) [M-MACH-102642]

**9.21 Module: Major Field: Development of Innovative Appliances and Power Tools (SP 51) [M-MACH-102642]**

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

**Part of:**  
- Specialization / Specialization: General Mechanical Engineering (Major Fields)  
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)  
- Specialization / Specialization: Vehicle Technology (Major Field)  
- Specialization / Specialization: Product Development and Engineering Design (Major Field (p))  
- Specialization / Specialization: Production Technology (Major Field)

<table>
<thead>
<tr>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
<th>Level</th>
<th>Version</th>
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<td>16</td>
<td>Grade to a tenth</td>
<td>Each term</td>
<td>2 terms</td>
<td>German/English</td>
<td>4</td>
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</table>

**Election regulations**  
Elections in this module must be complete and require confirmation. Election is only possible until the lower bounds are reached.

### Mandatory

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<tr>
<th>Module Code</th>
<th>Module Name</th>
<th>Credits</th>
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<tbody>
<tr>
<td>T-MACH-105229</td>
<td>Appliance and Power Tool Design</td>
<td>2 CR</td>
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<tr>
<td>T-MACH-110767</td>
<td>Appliance and Power Tool Design Project Work</td>
<td>6 CR</td>
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</table>

### Election block: Development of innovative appliances and power tools (E) ()

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Module Name</th>
<th>Credits</th>
<th>Responsible</th>
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<tbody>
<tr>
<td>T-MACH-105212</td>
<td>CAE-Workshop</td>
<td>4 CR</td>
<td>Albers, Matthiesen</td>
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<tr>
<td>T-INFO-110819</td>
<td>Edge-AI in Software and Sensor Applications</td>
<td>4 CR</td>
<td>Pankratius, Pankratius</td>
</tr>
<tr>
<td>T-MACH-105330</td>
<td>Design with Plastics</td>
<td>4 CR</td>
<td>Liedel</td>
</tr>
<tr>
<td>T-MACH-105221</td>
<td>Lightweight Engineering Design</td>
<td>4 CR</td>
<td>Albers, Burkardt</td>
</tr>
<tr>
<td>T-MACH-105231</td>
<td>Leadership and Management Development</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Ploch</td>
</tr>
<tr>
<td>T-MACH-101910</td>
<td>Microactuators</td>
<td>4 CR</td>
<td>Kohl</td>
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<tr>
<td>T-MACH-102152</td>
<td>Novel Actuators and Sensors</td>
<td>4 CR</td>
<td>Kohl, Sommer</td>
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<tr>
<td>T-MACH-105442</td>
<td>Intellectual Property Rights and Strategies in Industrial Companies</td>
<td>4 CR</td>
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<tr>
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<td>4 CR</td>
<td>Ays, Geerling</td>
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<tr>
<td>T-MACH-105347</td>
<td>Project Management in Global Product Engineering Structures</td>
<td>4 CR</td>
<td>Albers, Gutzmer, Matthiesen</td>
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<tr>
<td>T-MACH-102107</td>
<td>Quality Management</td>
<td>4 CR</td>
<td>Lanza</td>
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<tr>
<td>T-MACH-105696</td>
<td>Strategic Product Development - Identification of Potentials of Innovative Products</td>
<td>3 CR</td>
<td>Albers, Matthiesen, Siebe</td>
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<tr>
<td>T-MACH-110396</td>
<td>Strategic Product Development - Identification of Potentials of Innovative Products - Case Study</td>
<td>1 CR</td>
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### Election block: Development of innovative appliances and power tools (P) (at most 4 credits)

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Module Name</th>
<th>Credits</th>
<th>Responsible</th>
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</thead>
<tbody>
<tr>
<td>T-MACH-105370</td>
<td>Laboratory Mechatronics</td>
<td>4 CR</td>
<td>Hagenmeyer, Seemann, Stiller</td>
</tr>
</tbody>
</table>

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

**Competence Goal**  
Graduates are able to analyze and to synthesize complex technical products under consideration of customer, business and market demands. Specifically, they can address specific boundary conditions of devices and power tool manufacturers in power-tool development. They and are able to take into account the resulting effects of complex product development projects: e.g. the production in large quantities, complexity of mechatronic solutions or workflow management of interdisciplinary and distributed development teams. The graduates are able to assess and optimize their work results in terms of quality, costs and user benefits. They have a holistic insight into the processes that are necessary for creating products in this specific context and thus are prepared for the technical and non-technical requirements of responsible positions in the team-oriented product development of devices and power tools.
Prerequisites
Due to organizational reasons, the number of participants is limited. At the beginning of August, a registration form will be available at the IPEK website. In the case of too many applicants, a selection process will be taking place. An early application is advantageous.

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lecture, exercise.
## 9.22 Module: Major Field: Energy Converting Engines (SP 24) [M-MACH-102627]

### Responsible
Prof. Dr. Thomas Koch

### Organisation
KIT Department of Mechanical Engineering

### Part of:
- Specialization / Specialization: General Mechanical Engineering (Major Fields)
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)
- Specialization / Specialization: Vehicle Technology (Major Field)
- Specialization / Specialization: Product Development and Engineering Design (Major Field)

### Credits
16

### Grading scale
Grade to a tenth

### Recurrence
Each term

### Duration
2 terms

### Language
German/English

### Level
4

### Version
4

### Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

<table>
<thead>
<tr>
<th>Election block: Energy Converting Engines (K) (at least 8 credits)</th>
</tr>
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<tbody>
<tr>
<td>T-MACH-111550 CO2-Neutral Combustion Engines and their Fuels I</td>
</tr>
<tr>
<td>T-MACH-105326 Hydraulic Fluid Machinery</td>
</tr>
<tr>
<td>T-MACH-105363 Thermal Turbomachines I</td>
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</table>

<table>
<thead>
<tr>
<th>Election block: Energy Converting Engines (E) (at most 9 credits)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-CIWVT-105780 Design of a Jet Engine Combustion Chamber</td>
</tr>
<tr>
<td>T-MACH-111623 Fuels and Lubricants for Engine Powertrains</td>
</tr>
<tr>
<td>T-MACH-111560 CO2-Neutral Combustion Engines and their Fuels II</td>
</tr>
<tr>
<td>T-MACH-105515 Introduction to Numerical Fluid Dynamics</td>
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<tr>
<td>T-MACH-110817 Development of hybrid drivetrains</td>
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<tr>
<td>T-MACH-105512 Experimental Fluid Mechanics</td>
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<td>T-MACH-102093 Fluid Power Systems</td>
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<tr>
<td>T-MACH-105533 Gasdynamics</td>
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<tr>
<td>T-MACH-110816 Großdiesel- und -gasmotoren für Schiffsantriebe</td>
</tr>
<tr>
<td>T-MACH-105044 Fundamentals of Catalytic Exhaust Gas Aftertreatment</td>
</tr>
<tr>
<td>T-MACH-105213 Fundamentals of Combustion I</td>
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<tr>
<td>T-MACH-105325 Fundamentals of Combustion II</td>
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<tr>
<td>T-MACH-105338 Numerical Fluid Mechanics</td>
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<td>T-MACH-105337 Engine Laboratory</td>
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<td>T-MACH-111578 Sustainable Vehicle Drivetrains</td>
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<td>T-MACH-111022 Physical Measurement Technology</td>
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<td>T-MACH-105441 Development of Oil-Hydraulic Powertrain Systems</td>
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<td>T-MACH-107447 Reliability Engineering I</td>
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<td>T-MACH-105652 Fundamentals of Combustion Engine Technology</td>
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<td>T-MACH-105364 Thermal Turbomachines II</td>
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<td>T-MACH-105365 Turbine and Compressor Design</td>
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<td>T-MACH-105366 Turbo Jet Engines</td>
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<tr>
<td>T-MACH-111591 Turbo Charging of Internal Combustion Engines</td>
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<td>T-MACH-102148 Gear Cutting Technology</td>
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<td>T-MACH-111585 Hydrogen and reFuels - Energy Conversion in Combustion Engines</td>
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<tr>
<td>T-MACH-105234 Windpower</td>
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<td>T-MACH-105784 Vortex Dynamics</td>
</tr>
<tr>
<td>T-MACH-105985 Ignition Systems</td>
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</table>
Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Die Studierenden erwerben in den grundlagenorientierten Kernfächer des Schwerpunktes breite und fundierte Kenntnisse der wissenschaftlichen Theorien, Prinzipien und Methoden der Kraft- und Arbeitsmaschinen, um diese entwerfen, einsetzen und bewerten zu können.
Darauf aufbauend vertiefen die Studierenden in den Ergänzungsfächern ausgewählte Anwendungsfelder, sodass sie im Anschluss in der Lage sind, Probleme aus diesem Anwendungsfeld selbstständig zu analysieren, zu bewerten und hierauf aufbauend Lösungsansätze zu entwickeln.

Die Studierenden können nach Abschluss des Schwerpunkts insbesondere

- Funktion und Einsatz von Kraft- und Arbeitsmaschinen benennen,
- den Stand der Technik und daraus resultierende Anwendungsfelder der Kraft- und Arbeitsmaschinen beschreiben und am Beispiel anzuwenden,
- grundlegende Theorien, Methoden und Eigenschaften für die verschiedenen Anwendungsfelder der Kraft- und Arbeitsmaschinen benennen und diese einsetzen und bewerten.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lecture, tutorial.
Module: Major Field: Energy Technology for Buildings (SP 55) [M-MACH-102648]

Responsible: Prof. Dr. Robert Stieglitz
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Major Fields)
Specialization / Specialization: Energy- and Environment Engineering (Major Field)

Credits 16
Grading scale Grade to a tenth
Recurrence Each term
Duration 2 terms
Language German/English
Level 4
Version 3

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory
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<tr>
<td>T-MACH-105559</td>
<td>Technical Energy Systems for Buildings 1: Processes &amp; Components</td>
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Election block: Energy Technology for Buildings (K) (at least 4 credits)
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<tr>
<td>T-MACH-105715</td>
<td>Energy demand of buildings – fundamentals and applications, with building simulation exercises</td>
<td>6</td>
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<tr>
<td>T-MACH-105560</td>
<td>Technical Energy Systems for Buildings 2: System Concept</td>
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Election block: Energy Technology for Buildings (E) (at most 8 credits)
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<td>T-ARCH-107406</td>
<td>Energy and Indoor Climate Concepts</td>
<td>4</td>
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<td>T-MACH-105408</td>
<td>Energy Systems I: Renewable Energy</td>
<td>4</td>
<td>Dagan</td>
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<td>T-ETIT-100724</td>
<td>Photovoltaic System Design</td>
<td>3</td>
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<td>T-MACH-111022</td>
<td>Physical Measurement Technology</td>
<td>4</td>
<td>Buchenau, Stieglitz</td>
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<td>Thermal Solar Energy</td>
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<td>Thermal-Fluid-Dynamics</td>
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<td>Heatpumps</td>
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<td>Maas, Wirbser</td>
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<tr>
<td>T-MACH-105234</td>
<td>Windpower</td>
<td>4</td>
<td>Lewald</td>
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Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
After completing the courses in SP 55 „Energy technology for buildings" the students have achieved a comprehensive overview on the energy demand for air-conditioning of buildings (heating, cooling, humidification, dehumidification, ventilation) and the techniques for energy supply of buildings (heat, cold, locally generated electricity). They know the methods for evaluation of technologies regarding ecologic, criteria, primary energy and economic viability and they have the ability to apply these methods to concrete cases. They also have gained knowledge on all renewable energy technologies that are relevant for application in buildings, in particular solar thermal collectors and systems and photovoltaic systems as well as energy storage technologies that are applied in buildings (heat storage, batteries).

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lecture, exercise.
### 9.24 Module: Major Field: Engineering Design (SP 10) [M-MACH-102605]

| Responsible: | Prof. Dr.-Ing. Albert Albers |
| Organisation: | KIT Department of Mechanical Engineering |
| Part of: | Specialization / Specialization: General Mechanical Engineering (Major Fields) |
| | Specialization / Specialization: Energy- and Environment Engineering (Major Field) |
| | Specialization / Specialization: Vehicle Technology (Major Field) |
| | Specialization / Specialization: Product Development and Engineering Design (Major Field) |

**Credits**: 16  
**Grading scale**: Grade to a tenth  
**Recurrence**: Each term  
**Duration**: 2 terms  
**Language**: German/English  
**Level**: 4  
**Version**: 3

**Election notes**
In the core area of Major Field at least 8 ECTS have to be chosen.

#### Election block: Engineering Design (K) (at least 8 credits)

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<tr>
<td>T-MACH-105233</td>
<td>Powertrain Systems Technology A: Automotive Systems</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Ott</td>
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<tr>
<td>T-MACH-105216</td>
<td>Powertrain Systems Technology B: Stationary Machinery</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Ott</td>
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<tr>
<td>T-MACH-105221</td>
<td>Lightweight Engineering Design</td>
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#### Election block: Engineering Design (E) (at most 8 credits)

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<tr>
<td>T-MACH-105315</td>
<td>Applied Tribology in Industrial Product Development</td>
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<td>Albers, Lorentz, Matthiesen</td>
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<td>T-MACH-105311</td>
<td>Design and Development of Mobile Machines</td>
<td>4 CR</td>
<td>Geimer, Siebert</td>
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<td>T-MACH-111398</td>
<td>Design of Fuel Cell Systems</td>
<td>4 CR</td>
<td>Haussmann</td>
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<td>T-MACH-105212</td>
<td>CAE-Workshop</td>
<td>4 CR</td>
<td>Albers, Matthiesen</td>
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<td>Designing with numerical methods in product development</td>
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<td>T-MACH-108374</td>
<td>Vehicle Ergonomics</td>
<td>4 CR</td>
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<td>Fundamentals for Design of Motor-Vehicle Bodies I</td>
<td>2 CR</td>
<td>Bardehle</td>
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<tr>
<td>T-MACH-102119</td>
<td>Fundamentals for Design of Motor-Vehicle Bodies II</td>
<td>2 CR</td>
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<td>T-MACH-105160</td>
<td>Fundamentals in the Development of Commercial Vehicles I</td>
<td>2 CR</td>
<td>Weber</td>
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<tr>
<td>T-MACH-105161</td>
<td>Fundamentals in the Development of Commercial Vehicles II</td>
<td>2 CR</td>
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<td>T-MACH-105162</td>
<td>Fundamentals of Automobile Development I</td>
<td>2 CR</td>
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<tr>
<td>T-MACH-105163</td>
<td>Fundamentals of Automobile Development II</td>
<td>2 CR</td>
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<td>T-MACH-105188</td>
<td>Integrative Strategies in Production and Development of High Performance Cars</td>
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<td>T-MACH-105231</td>
<td>Leadership and Management Development</td>
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<td>Albers, Matthiesen, Ploch</td>
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<td>T-MACH-105440</td>
<td>Leadership and Conflict Management</td>
<td>4 CR</td>
<td>Hatzl</td>
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<tr>
<td>T-MACH-110984</td>
<td>Production Technology for E-Mobility</td>
<td>4 CR</td>
<td>Fleischer, Ruhland</td>
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<tr>
<td>T-MACH-105441</td>
<td>Development of Oil-Hydraulic Powertrain Systems</td>
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<td>Ays, Geerling</td>
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<tr>
<td>T-MACH-105347</td>
<td>Project Management in Global Product Engineering Structures</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-102107</td>
<td>Quality Management</td>
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<td>Lanza</td>
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<tr>
<td>T-MACH-105171</td>
<td>Safety Engineering</td>
<td>4 CR</td>
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<td>T-MACH-105696</td>
<td>Strategic Product Development - Identification of Potentials of Innovative Products</td>
<td>3 CR</td>
<td>Albers, Matthiesen, Siebe</td>
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<td>T-MACH-110396</td>
<td>Strategic Product Development - Identification of Potentials of Innovative Products - Case Study</td>
<td>1 CR</td>
<td>Albers, Matthiesen, Siebe</td>
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<tr>
<td>T-MACH-105358</td>
<td>Sustainable Product Engineering</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Ziegahn</td>
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Technical Acoustics
4 CR
Pantle, Walter

Technical Design in Product Development
4 CR
Albers, Matthiesen, Schmid

Gear Cutting Technology
4 CR
Klaiber

Machine Tools and High-Precision Manufacturing Systems
8 CR
Fleischer

Election block: Engineering Design (P) (at most 4 credits)

Laboratory Mechatronics
This item will not influence the grade calculation of this parent.
4 CR
Hagenmeyer, Seemann, Stiller

Programming in CAE-Applications
4 CR
Kärger

Project Internship Additive Manufacturing: Development and Production of an Additive Component
4 CR
Zanger

Election block: Engineering Design (Ü) ()

Design and Development of Mobile Machines - Advance
This item will not influence the grade calculation of this parent.
0 CR
Geimer, Siebert

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The students are able to transfer their knowledge und abilities in product engineering to mechanical systems in research and industrial practice.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials
Module: Major Field: Engineering Thermodynamics (SP 45) [M-MACH-102635]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- Specialization / Specialization: General Mechanical Engineering (Major Fields)
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)
- Specialization / Specialization: Vehicle Technology (Major Field)
- Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)
- Specialization / Specialization: Product Development and Engineering Design (Major Field)
- Specialization / Specialization: Theoretical Mechanical Engineering (Major Field)
- Specialization / Specialization: Materials and Structures for High Performance Systems (Major Field)

**Credits**
16

**Grading scale**
Grade to a tenth

**Recurrence**
Each term

**Duration**
2 terms

**Language**
German/English

**Level**
4

**Version**
4

**Election notes**
In the core area of the Major Field at least 8 ECTS have to be chosen.

### Election block: Engineering Thermodynamics (K) (at least 8 credits)

<table>
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<td>Fundamentals of Combustion I</td>
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<td>T-MACH-105325</td>
<td>Fundamentals of Combustion II</td>
<td>4</td>
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<td>T-MACH-105396</td>
<td>Modeling of Thermodynamical Processes</td>
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<td>T-MACH-105403</td>
<td>Flows and Heat Transfer in Energy Technology</td>
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### Election block: Engineering Thermodynamics (E) (at most 9 credits)

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<td>CO2-Neutral Combustion Engines and their Fuels I</td>
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<tr>
<td>T-MACH-111560</td>
<td>CO2-Neutral Combustion Engines and their Fuels II</td>
<td>5</td>
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<td>T-MACH-111193</td>
<td>Data Driven Engineering 1: Machine Learning for Dynamical Systems</td>
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<td>T-MACH-106373</td>
<td>Experimental techniques in thermo- and fluid-dynamics</td>
<td>4</td>
<td>CR</td>
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<td>T-MACH-105533</td>
<td>Gasdynamics</td>
<td>4</td>
<td>CR</td>
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<td>Mathematical Models and Methods in Combustion Theory</td>
<td>4</td>
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<td>Analysis Tools for Combustion Diagnostics</td>
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<td>Reduction Methods for the Modeling and the Simulation of Combustion Processes</td>
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<td>Thermal Turbomachines II</td>
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<td>Combustion Diagnostics</td>
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<td>Heatpumps</td>
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**Competence Certificate**

Oral exams: duration approx. 5 min. per credit point.
However, amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**

After completion of SP 45 students are able to:

- apply the thermodynamic fundamentals of reversible and irreversible processes.
- outline the fundamentals of experimental investigations, modeling and simulation of reacting flows.
- understand the working principle of technical systems applying thermodynamic processes and combustion.

**Prerequisites**

None
Content
Thermodynamics is considered to be the basis of all processes in nature and engineering. The major subject in this SP extends the thermodynamic knowledge of the attendees in irreversible thermodynamic processes and provides insight into the fundamentals of reactive flows.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials
Module: Major Field: Fluid Mechanic (SP 41) [M-MACH-102634]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- Specialization / Specialization: General Mechanical Engineering (Major Fields)
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)
- Specialization / Specialization: Vehicle Technology (Major Field)
- Specialization / Specialization: Product Development and Engineering Design (Major Field)
- Specialization / Specialization: Theoretical Mechanical Engineering (Major Field (p))

**Credits:** 16

**Grading scale:** Grade to a tenth

**Recurrence:** Each term

**Duration:** 2 terms

**Language:** German/English

**Level:** 4

**Version:** 5

**Election block: Fluid Mechanics (K) (at least 8 credits)**

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<td>T-BGU-110841</td>
<td>Fluid Mechanics of Turbulent Flows</td>
<td>6 CR</td>
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<td>Gasdynamics</td>
<td>4 CR</td>
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<td>Hydrodynamic Stability: From Order to Chaos</td>
<td>4 CR</td>
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<td>T-BGU-106758</td>
<td>Numerical Fluid Mechanics</td>
<td>6 CR</td>
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**Election block: Fluid Mechanics (E) (at most 2 items)**

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<td>4 CR</td>
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<td>T-MACH-105426</td>
<td>Magnetohydrodynamics</td>
<td>4 CR</td>
<td></td>
<td>Bühler</td>
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<tr>
<td>T-MACH-105295</td>
<td>Mathematical Methods in Fluid Mechanics</td>
<td>6 CR</td>
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<td>Frohnapfel</td>
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<tr>
<td>T-BGU-110842</td>
<td>Modeling of Turbulent Flows - RANS and LES</td>
<td>6 CR</td>
<td></td>
<td>Uhlmann</td>
</tr>
<tr>
<td>T-MACH-105420</td>
<td>Numerical Simulation of Multi-Phase Flows</td>
<td>4 CR</td>
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<td>Wörner</td>
</tr>
<tr>
<td>T-MACH-105339</td>
<td>Numerical Simulation of Reacting Two Phase Flows</td>
<td>4 CR</td>
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<td>Koch</td>
</tr>
<tr>
<td>T-MACH-105397</td>
<td>Numerical Simulation of Turbulent Flows</td>
<td>4 CR</td>
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<td>Grötzbach</td>
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<tr>
<td>T-MACH-105422</td>
<td>Flows with Chemical Reactions</td>
<td>4 CR</td>
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<td>Class</td>
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<tr>
<td>T-MACH-106372</td>
<td>Thermal-Fluid-Dynamics</td>
<td>4 CR</td>
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<td>Ruck</td>
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<tr>
<td>T-MACH-105406</td>
<td>Two-Phase Flow and Heat Transfer</td>
<td>4 CR</td>
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<td>Schulenberg, Wörner</td>
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</table>

**Election block: Fluid Mechanics (P) (at most 4 credits)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Grade</th>
<th>Instructor</th>
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<tbody>
<tr>
<td>T-MACH-111390</td>
<td>Advanced CFD with OpenFOAM</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-110838</td>
<td>Numerical Fluid Mechanics with PYTHON</td>
<td>4 CR</td>
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<td>Frohnapfel</td>
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</table>

**Competence Certificate**

Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**

After having completed this module the student is capable of deriving the relevant fluid mechanical equations and interpret the governed physics. He/She can describe the characteristic properties of fluids and can analyze flow scenarios. According to the chosen lectures, the student can capture flow scenarios with analytical, numerical and/or experimental means and is capable to evaluate the acquired results thoroughly.
Prerequisites
None

Content
See brick courses.

Workload
The workload is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials
### Module: Major Field: Fundamentals of Energy Technology (SP 15) [M-MACH-102623]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
Specialization / Specialization: General Mechanical Engineering (Major Fields)  
Specialization / Specialization: Energy- and Environment Engineering (mandatory)  
Specialization / Specialization: Vehicle Technology (Major Field)  
Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)  
Specialization / Specialization: Product Development and Engineering Design (Major Field)

<table>
<thead>
<tr>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
<th>Level</th>
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<td>Each term</td>
<td>2 terms</td>
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#### Mandatory

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<tr>
<td>T-MACH-105220</td>
<td>Fundamentals of Energy Technology</td>
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#### Election block: Fundamentals of Energy Technology (K) ()

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<tr>
<td>T-MACH-105525</td>
<td>Introduction to Nuclear Energy</td>
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<td>T-MACH-105325</td>
<td>Fundamentals of Combustion II</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105326</td>
<td>Hydraulic Fluid Machinery</td>
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#### Election block: Fundamentals of Energy Technology (E) ()

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<tbody>
<tr>
<td>T-MACH-105462</td>
<td>Selected Problems of Applied Reactor Physics and Exercises</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-111398</td>
<td>Design of Fuel Cell Systems</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-111623</td>
<td>Fuels and Lubricants for Engine Powertrains</td>
<td>4 CR</td>
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<td>T-MACH-111550</td>
<td>CO2-Neutral Combustion Engines and their Fuels I</td>
<td>4 CR</td>
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<td>T-MACH-111193</td>
<td>Data Driven Engineering 1: Machine Learning for Dynamical Systems</td>
<td>4 CR</td>
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<td>T-MACH-111373</td>
<td>Data Driven Engineering 2: Advanced Topics</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105151</td>
<td>Energy Efficient Intralogistic Systems</td>
<td>4 CR</td>
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<td>T-MACH-105408</td>
<td>Energy Systems I: Renewable Energy</td>
<td>4 CR</td>
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<td>T-MACH-105533</td>
<td>Gasdynamics</td>
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<td>T-MACH-105167</td>
<td>Analysis Tools for Combustion Diagnostics</td>
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<td>T-MACH-105557</td>
<td>Microenergy Technologies</td>
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<td>T-MACH-105339</td>
<td>Numerical Simulation of Reacting Two Phase Flows</td>
<td>4 CR</td>
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<td>T-MACH-105338</td>
<td>Numerical Fluid Mechanics</td>
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<td>T-ETIT-101939</td>
<td>Photovoltaics</td>
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<td>T-MACH-110984</td>
<td>Production Technology for E-Mobility</td>
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<td>T-MACH-106493</td>
<td>Solar Thermal Energy Systems</td>
<td>4 CR</td>
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<td>T-MACH-105403</td>
<td>Flows and Heat Transfer in Energy Technology</td>
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<td>T-MACH-105358</td>
<td>Sustainable Product Engineering</td>
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<td>T-MACH-111382</td>
<td>Technical Acoustics</td>
<td>4 CR</td>
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<td>T-MACH-105652</td>
<td>Fundamentals of Combustion Engine Technology</td>
<td>5 CR</td>
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<td>T-MACH-105225</td>
<td>Thermal Solar Energy</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105363</td>
<td>Thermal Turbomachines I</td>
<td>6 CR</td>
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<td>T-MACH-105234</td>
<td>Windpower</td>
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#### Election block: Fundamentals of Energy Technology (P) (at most 4 credits)

<table>
<thead>
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<tbody>
<tr>
<td>T-MACH-105313</td>
<td>CFD-Lab Using OpenFOAM</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105515</td>
<td>Introduction to Numerical Fluid Dynamics</td>
<td>4 CR</td>
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</tbody>
</table>
Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
After completion of SP 15 students are able:

- to describe the elements of an energy system and their complex interactions,
- to list different conventional energy sources and assess their static range,
- to name the fluctuating supply of renewable energies such as wind, solar radiation, ocean currents and tides etc. and describe its effects on the energy system,
- to assess the effects of external and internal economic, ecological and technical boundary conditions of energy systems and to derive approaches for an optimal mix of different energy technologies,
- to explain the operational principle of well-established power plants as well as of power plants based on renewable energies.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, tutorials.
### 9.28 Module: Major Field: Fusion Technology (SP 53) [M-MACH-102643]

**Responsible:** Prof. Dr. Robert Stieglitz  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- Specialization / Specialization: General Mechanical Engineering (Major Fields)  
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)  
- Specialization / Specialization: Theoretical Mechanical Engineering (Major Field)

<table>
<thead>
<tr>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
<th>Level</th>
<th>Version</th>
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<tr>
<td>16</td>
<td>Grade to a tenth</td>
<td>Each term</td>
<td>2 terms</td>
<td>German/English</td>
<td>4</td>
<td>2</td>
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</table>

**Election notes**
In the core area of Major Field at least 8 ECTS have to be chosen.

#### Election block: Fusion Technology (K) (at least 8 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Lecturer</th>
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</thead>
<tbody>
<tr>
<td>T-MACH-105411</td>
<td>Fusion Technology A</td>
<td>4 CR</td>
<td>Stieglitz</td>
</tr>
<tr>
<td>T-MACH-105433</td>
<td>Fusion Technology B</td>
<td>4 CR</td>
<td>Stieglitz</td>
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</table>

#### Election block: Fusion Technology (E) (at most 10 credits)

<table>
<thead>
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<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-MACH-105310</td>
<td>Design of Highly Stresses Components</td>
<td>4 CR</td>
<td>Aktaa</td>
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<tr>
<td>T-MACH-105407</td>
<td>CFD for Power Engineering</td>
<td>4 CR</td>
<td>Otic</td>
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<tr>
<td>T-MACH-106698</td>
<td>A holistic approach to power plant management</td>
<td>4 CR</td>
<td>Seidl, Stieglitz</td>
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<tr>
<td>T-MACH-105434</td>
<td>Magnet Technology of Fusion Reactors</td>
<td>4 CR</td>
<td>Fietz, Weiss</td>
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<tr>
<td>T-MACH-105426</td>
<td>Magnetohydrodynamics</td>
<td>4 CR</td>
<td>Bühler</td>
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<td>T-MACH-105435</td>
<td>Neutron Physics of Fusion Reactors</td>
<td>4 CR</td>
<td>Fischer</td>
</tr>
<tr>
<td>T-MACH-111022</td>
<td>Physical Measurement Technology</td>
<td>4 CR</td>
<td>Buchenau, Stieglitz</td>
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<tr>
<td>T-MACH-105456</td>
<td>Ten Lectures on Turbulence</td>
<td>4 CR</td>
<td>Otic</td>
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<td>T-MACH-106372</td>
<td>Thermal-Fluid-Dynamics</td>
<td>4 CR</td>
<td>Ruck</td>
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<td>T-MACH-105406</td>
<td>Two-Phase Flow and Heat Transfer</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-108784</td>
<td>Vacuum and Tritium Technology in Nuclear Fusion</td>
<td>4 CR</td>
<td>Day</td>
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**Competence Certificate**
- Oral exam: Acceptance for the oral test only by certification of attendance of excercises (can be given in English)  
- Duration: approximately 30 minutes

no tools or reference materials may be used during the exam

**Competence Goal**
Graduate in fusion technology acquire a fundamental knowledge of the fusion process and are enabled to deduce based on the physical boundary conditions technological and scientific engineering solutions to individual problems. Since fusion technology is intrinsically of interdisciplinary nature consisting of physics, mechanics, thermal-hydraulics, material sciences and electrical engineering incorporates, the focus of this topic is mainly devoted to allow for the understanding of the underlying physics and moreover to enable the students of couple the different disciplines. Here, mainly methtodologies and solution approaches are communicated to the graduates with the goal to capture critical issues within multi-physics problems, to identify central challenges within the given problem and to enable them to elaborate engineering solution concepts. Aside from the analysis of the relevance/importance of aspects within a complex multi-physics problem graduates are prepared to take decisions based on a solid physics basis and to formulate solution approaches.

The reliable handling of different physical phenomena from different disciplines and the methodological capability to tackle multi-physics questions and to extract from them central core issues qualifies the graduates for a competent and successful career not only in fusion technology but also in neighboring fields such energy energiering as well as process, chemical and environmental engineering both in the research and development context but also in the project management.

**Prerequisites**
None
Content
Actual energy situation and perspectives. Elementary particle physics, principles of nuclear fusion and nuclear fission. What is a plasma and how it can be confined? How stable is a plasma and conditions for an ignition, control of a plasma and transport in plasmas. Plasmas are confined contactless by means of magnetic fields. Hence fundamentals of the magnet technology, super-conductivity, materials in super-conductivity, fabrication and design of magnets are elaborated. A fusion reactor breeds its own fuel Tritium, which is radioactive. Tritium poses specific requirements regarding separation, conditioning and the fuel cycle, for which the physical and technological basis are outlined. Fusion plasmas are characterized by a small particle density and hence a vacuum is required. Simultaneously plasmas generate high temperatures and heat loads necessitating dedicated designs of plasma facing components at a considerable neutron irradiation. in both technology fields the tasks, requirements and challenges are formulated and how they translate to the current "state of the art" are illustrated. Moreover, an introduction into design criteria and calculation methods to select adequate vacuum pumps and to design plasma facing components is provided.

Recommendation
appreciated is knowledge in heat and mass transfer as well as in electrical engineering
Basic knowledge in fluid mechanics, material sciences and physics

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lecture, presentation (transparencies nearly exclusively in english) complemented by print-outs and exercises
9.29 Module: Major Field: Information Technology (SP 18) [M-MACH-102624]

Responsible: Prof. Dr.-Ing. Christoph Stiller
Organisation: KIT Department of Mechanical Engineering

Part of:
- Specialization / Specialization: General Mechanical Engineering (Major Fields)
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)
- Specialization / Specialization: Vehicle Technology (Major Field)
- Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)
- Specialization / Specialization: Product Development and Engineering Design (Major Field)
- Specialization / Specialization: Theoretical Mechanical Engineering (Major Field)

Credits: 16
Grading scale: Grade to a tenth
Recurrence: Each term
Duration: 2 terms
Language: German/English
Level: 4
Version: 5

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Information Technology (K) (at least 8 credits)

<table>
<thead>
<tr>
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<th>Module Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>T-MACH-105314</td>
<td>Computational Intelligence</td>
<td>4 CR</td>
<td>Mikut, Reinartz, Reischl</td>
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<tr>
<td>T-MACH-105694</td>
<td>Data Analytics for Engineers</td>
<td>5 CR</td>
<td>Meisenbacher, Mikut, Reischl</td>
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<tr>
<td>T-MACH-105317</td>
<td>Digital Control</td>
<td>4 CR</td>
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<td>T-MACH-105223</td>
<td>Machine Vision</td>
<td>8 CR</td>
<td>Lauer, Stiller</td>
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<tr>
<td>T-MACH-105335</td>
<td>Measurement II</td>
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Election block: Information Technology (E) (at most 8 credits)

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<th>Module Title</th>
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<tr>
<td>T-MACH-102150</td>
<td>BUS-Controls</td>
<td>4 CR</td>
<td>Becker, Geimer</td>
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<tr>
<td>T-MACH-111193</td>
<td>Data Driven Engineering 1: Machine Learning for Dynamical Systems</td>
<td>4 CR</td>
<td>Bauer</td>
</tr>
<tr>
<td>T-MACH-111373</td>
<td>Data Driven Engineering 2: Advanced Topics</td>
<td>4 CR</td>
<td>Bauer</td>
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<tr>
<td>T-MACH-105218</td>
<td>Automotive Vision</td>
<td>6 CR</td>
<td>Lauer, Stiller</td>
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<tr>
<td>T-MACH-102128</td>
<td>Information Systems and Supply Chain Management</td>
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<td>Kilger</td>
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<td>T-INFO-101466</td>
<td>Information Processing in Sensor Networks</td>
<td>6 CR</td>
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<td>IT-Fundamentals of Logistics</td>
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<tr>
<td>T-MACH-105169</td>
<td>Engine Measurement Techniques</td>
<td>4 CR</td>
<td>Bernhardt</td>
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<tr>
<td>T-MACH-105341</td>
<td>Lab Computer-Aided Methods for Measurement and Control</td>
<td>4 CR</td>
<td>Stiller</td>
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<tr>
<td>T-MACH-107447</td>
<td>Reliability Engineering 1</td>
<td>3 CR</td>
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<td>T-MACH-105185</td>
<td>Control Technology</td>
<td>4 CR</td>
<td>Gönnheimer</td>
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<td>T-MACH-105367</td>
<td>Behaviour Generation for Vehicles</td>
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Election block: Information Technology (Ü) ()

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<tbody>
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<td>T-MACH-108889</td>
<td>BUS-Controls - Advance</td>
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Competence Certificate
Oral exams: duration approx 5 min. per credit point.

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

Competence Goal
Students are able to
- explain fundamentals of information technology for given problems in mechanical engineering an mechatronics.
- explain major methods for acquisition, processing and exploitation of information in technical systems.
- outline and to explain alternative methods to determine and to represent measurement uncertainties and their propagation in technical systems.
- explain information filters and fusion methods and understand their application to given problems.
Prerequisites
none

Content
• Techniques of information and data processing in mechanical engineering
• Techniques of sensor data processing
• Concepts of control theory
• Electronic devices for data processing

Workload
The workload is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, tutorials.
9.30 Module: Major Field: Information Technology of Logistic Systems (SP 19) [M-MACH-102625]

**Responsible:** Prof. Dr.-Ing. Kai Furmans

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- Specialization / Specialization: General Mechanical Engineering (Major Fields)
- Specialization / Specialization: Product Development and Engineering Design (Major Field)
- Specialization / Specialization: Production Technology (Major Field)

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<th>Duration</th>
<th>Language</th>
<th>Level</th>
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**Mandatory**

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<td>Logistics and Supply Chain Management</td>
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**Election block: Information Technology of Logistic Systems (E) ()**

<table>
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<th>Course Title</th>
<th>CR</th>
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<tbody>
<tr>
<td>T-MACH-105218</td>
<td>Automotive Vision</td>
<td>6</td>
<td>Lauer, Stiller</td>
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<tr>
<td>T-MACH-105174</td>
<td>Warehousing and Distribution Systems</td>
<td>3</td>
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<td>T-MACH-105175</td>
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<td>Information Systems and Supply Chain Management</td>
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</table>

**Competition Certificate**

Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

**Competition Goal**

Students are able to:

- Describe and explain soft- and hardware for logistical systems including Supply-Chains,
- Choose control mechanisms and communication systems and describe their basic functions,
- Compare strength and weaknesses of different approaches and evaluate the fundamental suitability.

**Prerequisites**

None

**Content**

This emphasis module focuses on automation technology in material flow as well as the information technology that has a direct relationship with it. Information systems to support logistic processes are presented. It is shown how requirements of a supply chain can be identified and an appropriate information system can be choosen. Furthermore basic for the main topics of logistics are provided. To gain a deeper understanding, the courses are accompanied by exercises and partly by case studies.

**Workload**

The work load is about 480 hours, corresponding to 16 credit points.

**Learning type**

Lectures and practices; self-study
Module: Major Field: Innovation and Entrepreneurship (SP 59) [M-MACH-104323]

**Responsible:** apl. Prof. Dr. Andreas Class  
Prof. Dr. Orestis Terzidis  

**Organisation:** KIT Department of Mechanical Engineering  

**Credits** 16  
**Grading scale** Grade to a tenth  
**Recurrence** Each term  
**Duration** 2 terms  
**Language** English  
**Level** 4  
**Version** 2  

**Election notes**  
In the core area of Major Field at least 8 ECTS have to be chosen.

**Election block: Innovation und Entrepreneurship (K) (at least 8 credits)**

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Module Name</th>
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<td>Innovative Project</td>
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**Election block: Innovation und Entrepreneurship (E) (at most 11,5 credits)**

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**Competence Certificate**  
Oral exams: duration approx. 5 minutes per credit point.  
Amount, type and scope of the success control can vary according to individual choice.

**Competence Goal**  
After completion of the module students  
- know the principles of innovation and entrepreneurship  
- can initiate patent research  
- can name, compare and use the central methods and process models of product development within moderate complex technical systems.

**Prerequisites**  
none

**Content**  
The module introduces the basic concepts of entrepreneurship and illustrates the different stages of the dynamic development of a company.  
The topics include:  
- introduction to methods for generating innovative business ideas  
- translating patents into business concepts  
- general principles of financial planning  
- the design and implementation of service-oriented information systems for Entrepreneurs  
- Technology Management and Business Model Generation and “Lean Startup” methods for the implementation of business ideas by the way of controlled experiments in the market  
- basics of product development.

**Workload**  
The work load is about 480 hours, corresponding to 16 credit points. 1 LP = 30 working hours

**Learning type**  
Seminar, lecture, project
Module: Major Field: Integrated Product Development [M-MACH-102626]

**Responsible:** Prof. Dr.-Ing. Albert Albers  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
Specialization / Specialization: General Mechanical Engineering (Major Fields)  
Specialization / Specialization: Energy- and Environment Engineering (Major Field)  
Specialization / Specialization: Vehicle Technology (Major Field)  
Specialization / Specialization: Product Development and Engineering Design (Major Field (p))  
Specialization / Specialization: Production Technology (Major Field)

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<th>Duration</th>
<th>Language</th>
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<td>Each winter term</td>
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**Mandatory**

| T-MACH-105401 | Integrated Product Development | 16 CR Albers, Albers Assistenten |

**Competence Certificate**
oral examination (60 minutes)

**Competence Goal**
By working practically in experience-based learning arrangements with industrial development tasks, graduates are able to succeed in new and unknown situations when developing innovative products by using methodological and systematic approaches. They can apply and adapt strategies of development and innovation management, technical system analysis and team leadership to the situation. As a result, they are able to foster the development of innovative products in industrial development teams in prominent positions, taking into account social, economic and ethical aspects.

**Prerequisites**
None

**Content**
Organizational integration: integrated product development model, core team management and simultaneous engineering, informational integration: innovation management, cost management, quality management and knowledge management  
Personal integration: team development and leadership  
Guest lectures from the industry

**Annotation**
The participation in the course "Integrated Product Development" requires the simultaneous participation in the lecture (2145156), the workshop (2145157) and the product development project (2145300).

For organizational reasons, the number of participants for the product development project is limited. Therefore, a selection process will take place. Registration for the selection process is made by means of a registration form, which is available annually from April to July on the homepage of the IPEK. Afterwards the selection itself will be discussed in personal interviews with Professor Albers.

The rule here is:

- Students within the course of studies will be decided on the basis of their progress (not only with semesters), which will be determined in a personal interview. The personal selection interviews take place in addition, in order to make the students aware of the special project-oriented format and the time required in correlation with the ECTS points of the course before the final registration for the course.
- With the same study progress after waiting period  
- With same waiting time by lot.  
- The same procedure is used for students from other courses.

**Workload**
The work load is about 480 hours, corresponding to 16 credit points.

**Learning type**
lecture  
tutorial  
product development project
### Module: Major Field: Lifecycle Engineering (SP 28) [M-MACH-102613]

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

**Part of:**  
Specialization / Specialization: General Mechanical Engineering (Major Fields)  
Specialization / Specialization: Vehicle Technology (Major Field)  
Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)  
Specialization / Specialization: Product Development and Engineering Design (Major Field (p))  
Specialization / Specialization: Production Technology (Major Field (p))

**Credits**  
16

**Grading scale**  
Grade to a tenth

**Recurrence**  
Each term

**Duration**  
2 terms

**Language**  
German/English

**Level**  
4

**Version**  
4

### Election notes

In the core area of Major Field at least 8 ECTS have to be chosen.

### Mandatory

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### Election block: Lifecycle Engineering (E) ()

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<td>Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice</td>
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<td>Mathematical Models and Methods for Production Systems</td>
<td>6 CR</td>
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<td>T-MACH-105523</td>
<td>Productivity Management in Production Systems</td>
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<td>Virtual Solution Methods and Processes</td>
<td>4 CR</td>
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### Election block: Lifecycle Engineering, Practical Lab (at most 1 item)

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<td>2 CR</td>
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### Competence Certificate

Oral exams: duration approx. 5 min. per credit point.  
However, amount, type and scope of the success control can vary according to the individually choice.
**Competence Goal**
Student gain a basic understanding of holistic development, validation and production of products, components and systems. Students are able to appreciate the product and process complexity of today’s products and manufacturing facilities. They know exemplary IT-Systems to support the complexity.

Students can describe the necessary information management for the product emergence process.

Students know the fundamental terms or virtual reality and are able to use a CAVE as tool to promote technical or management decisions.

**Prerequisites**
None

**Content**
Virtual Engineering, methods of product development and production, CAD, CAE, CAx, Virtual and Augmented Reality, digital twin.

**Workload**
The work load is about 480 hours, corresponding to 16 credit points.

**Learning type**
Lectures, exercises, project work in teams, workshop, Learning by Doing
### 9.34 Module: Major Field: Lightweight Construction (SP 25) [M-MACH-102628]

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

**Part of:**  
- Specialization / Specialization: General Mechanical Engineering (Major Fields)  
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)  
- Specialization / Specialization: Vehicle Technology (Major Field)  
- Specialization / Specialization: Product Development and Engineering Design (Major Field)  
- Specialization / Specialization: Materials and Structures for High Performance Systems (Major Field)

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**Election notes**  
In the core area of Major Field at least 8 ECTS have to be chosen.

#### Mandatory

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<td>T-MACH-105535</td>
<td>Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies</td>
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#### Election block: Lightweight Construction (E) ()

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<td>4 CR</td>
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<td>Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice</td>
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<td>Gruber, Gumbsch</td>
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<td>Failure of Structural Materials: Deformation and Fracture</td>
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<td>T-CHEMBIO-100294</td>
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#### Election block: Lightweight Construction (P) (at most 4 credits)

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Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Lightweight design is the realization of a development strategy, which aims at fulfilling a required function over the product life under specified boundary conditions by a system of minimal weight.

Therefore, lightweight design can always be described as an optimization problem, that must be solved as efficiently as possible by suitable measures. With regard to the automotive industry, this means reducing the total vehicle weight without negatively affecting important properties such as the bodywork stiffness or crash characteristics.

In order to solve the optimization problem of lightweight design technically and economically efficient, an interdisciplinary approach is required. This means that specific know-how is required in many areas of materials science and engineering, as well as interdisciplinary thinking.

Exploiting the full potential of lightweight design therefore requires the systematic development of materials, the development and adaption of suitable manufacturing and finishing processes, as well as the development of simulation tools and design methods for innovative lightweight constructions.

Students acquire the skill to name the basics of lightweight design and to apply them to problems in various areas of mechanical engineering, in particular materials, methods and production.

As an elementary component of the module, the students can explain and apply the materials relevant for lightweight design. The students are able to describe and compare the materials important for lightweight design and to select the corresponding methods for construction, design and dimensioning under consideration of suitable manufacturing technologies.

Based on examples, which are also used in industry, the students learn to select suitable materials, to describe them with suitable methods and to develop products under consideration of the manufacturing process. The students learn to analyze processes and to assess their efficiency.

Prerequisites
None

Content
See brick courses.

Recommendation
The following courses are recommended in the election block for:

1. Focus on methods and simulation
   - T-MACH-105970 Structural Analysis of Composite Laminates
   - T-MACH-105971 Simulation of the process chain of continuously fiber reinforced composite structure
   - T-MACH-110954 Lightweight constructions with fiber-reinforced-polymers – theory and practice
   - T-MACH-105221 Lightweight Engineering Design

2. Focus on materials science
   - T-MACH-105211 Materials of Lightweight Construction
   - T-MACH-102137 Polymer Engineering I
   - T-MACH-110954 Lightweight constructions with fiber-reinforced-polymers – theory and practice
   - T-MACH-110937 Materials Recycling and Sustainability (as of WS 20/21)

3. Focus on production science
   - T-MACH-108844 Automated Manufacturing Systems
   - T-MACH-110954 Lightweight constructions with fiber-reinforced-polymers – theory and practice

The following major fields are recommended in combination with SP 25 "Lightweight Construction" for:

1. Focus on methods and simulation
   - SP 30 Applied Mechanics (Böhlke)
   - SP 56 Advanced Materials Modelling (Böhlke)
   - SP 41 Fluid Mechanic (Frohnnapfel)

2. Focus on materials science
   - SP 36 Polymer Engineering (Elsner)
   - SP 26 Materials Science and Engineering (Heilmaier)

3. Focus on production science
   - SP 39 Production Technology (Schulze)
Workload
The workload is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials
**Module: Major Field: Logistics and Material Flow Theory (SP 29) [M-MACH-102629]**

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

**Part of:**  
- Specialization / Specialization: General Mechanical Engineering (Major Fields)  
- Specialization / Specialization: Product Development and Engineering Design (Major Field)  
- Specialization / Specialization: Production Technology (Major Field (p))

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**Election block: Logistics and Material Flow Theory (E) ()**

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

**Competence Goal**  
**Students**

- acquire comprehensive and well-founded knowledge on the main topics of logistics, an overview of different logistic questions in practice and knows the functionality of material handling systems,
- are able to illustrate logistic systems with adequate accuracy by using simple models,
- are able to realize coherences within logistic systems,
- are able to evaluate logistic systems by using the learnt methods,
- are able to analyze and explain the phenomena of industrial material and value streams
- are able to plan logistic systems and evaluate their performance,
- can use approaches of Supply Chain Management within the operational practice,
- identify, analyse and evaluate risks within logistic systems.

**Prerequisites**
None

**Content**  
The emphasis module *Material Flow and Logistics* provides comprehensive and well-founded basics for the main topics of logistics. Within the lectures, the interaction between several components of logistic systems will be shown. The module focuses on technical characteristics of material handling systems as well as on methods for illustrating and evaluating logistics systems. Furthermore the main topics of logistics and industrial material and value streams can be focused on by queuing methods to model production systems. Another focus can be set on basic methods for planning and running logistic systems or special issues like supply chain management. To gain a deeper understanding, the courses are accompanied by exercises and partly by case studies.

**Workload**  
The work load is about 480 hours, corresponding to 16 credit points.
Learning type
Lectures and practices; self-study
### Module: Major Field: Man - Technology - Organisation (SP 03) [M-MACH-102600]

**Responsible:** Prof. Dr.-Ing. Barbara Deml  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- Specialization / Specialization: General Mechanical Engineering (Major Fields)  
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)  
- Specialization / Specialization: Product Development and Engineering Design (Major Field)  
- Specialization / Specialization: Production Technology (Major Field (p))

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**Election block: Man - Technology - Organisation (E) (at most 8 credits)**

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**Competence Certificate**

See chosen brick course

**Competence Goal**

The students acquire a basic knowledge in the field of 1. ergonomics and 2. work organisation:

1. They are able to consider cognitive, physiological, anthropometric, and safety technical aspects in order to design workplaces ergonomically. Just as well they know physical and psycho-physical fundamentals (e. g. noise, lighting, climate) in the field of work-environmental design. Furthermore the students are able to evaluate workplaces by knowing and being able to apply essential methods of time studies and payment systems. Finally, they get a first, overall insight into the German labour law as well as into the organisation of advocacy groups beyond companies.

2. Within this module the students gain also a fundamental knowledge in the field of structural, process, and production organization. Besides, they get to know basic aspects of industrial teamwork and they know relevant theories in the field of interaction and communication, the management of employees as well as work satisfaction and motivation. Finally, the students get to know also methods in the field of personnel selection, development, and assessment.

Further on they get to know basic methods of behavioral-science data acquisition (e. g. eye-tracking, ECG, dual-task-paradigm) and they gain a first insight into empirical research methods (e. g. experimental design, statistical data evaluation). Selected complementary subjects deepen or extend the above mentioned learning outcomes.

**Prerequisites**

None

**Content**

See chosen brick courses.

**Workload**

The work load is about 480 hours, corresponding to 16 credit points.
Learning type
Lectures, Tutorials
### 9.37 Module: Major Field: Materials Science and Engineering (SP 26) [M-MACH-102611]

**Responsibility:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- Specialization / Specialization: General Mechanical Engineering (Major Fields)  
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)  
- Specialization / Specialization: Vehicle Technology (Major Field)  
- Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)  
- Specialization / Specialization: Product Development and Engineering Design (Major Field)  
- Specialization / Specialization: Production Technology (Major Field)  
- Specialization / Specialization: Theoretical Mechanical Engineering (Major Field)  
- Specialization / Specialization: Materials and Structures for High Performance Systems (Major Field (p))

#### Credits  
16

#### Grading scale  
Grade to a tenth

#### Recurrence  
Each term

#### Duration  
2 terms

#### Language  
German/English

#### Level  
4

#### Version  
5

### Election notes

In the core area of Major Field at least 8 ECTS have to be chosen.

**Election block: Compulsory Elective Subjects (1 item)**

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**Election block: Materials Science and Engineering (E) (at most 10 credits)**

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<td>4 CR</td>
<td>Weygand</td>
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<tr>
<td>T-MACH-110937</td>
<td>Materials Recycling and Sustainability</td>
<td>4 CR</td>
<td>Elsner, Liebig</td>
</tr>
</tbody>
</table>

**Election block: Materials Science and Engineering (P) (at most 4 credits)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Instructor(s)</th>
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<tbody>
<tr>
<td>T-MACH-105651</td>
<td>Biomechanics: Design in Nature and Inspired by Nature</td>
<td>4 CR</td>
<td>Mattheck</td>
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<tr>
<td>T-MACH-105447</td>
<td>Metallographic Lab Class</td>
<td>4 CR</td>
<td>Heilmaier, Mühl</td>
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<tr>
<td>T-MACH-102154</td>
<td>Laboratory Laser Materials Processing</td>
<td>4 CR</td>
<td>Schneider</td>
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</tbody>
</table>

**Election block: Materials Science and Engineering (Ü) (at most 1 credit)**

<table>
<thead>
<tr>
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<th>Course Title</th>
<th>Credits</th>
<th>Instructor(s)</th>
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</thead>
<tbody>
<tr>
<td>T-MACH-111027</td>
<td>Tutorial Nonlinear Continuum Mechanics</td>
<td>1 CR</td>
<td>Böhlike</td>
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<tr>
<td>T-MACH-107632</td>
<td>Exercises for Solid State Reactions and Kinetics of Phase Transformations</td>
<td>2 CR</td>
<td>Franke, Seifert</td>
</tr>
<tr>
<td>T-MACH-110379</td>
<td>Tutorial Mathematical Methods in Micromechanics</td>
<td>1 CR</td>
<td>Böhlike</td>
</tr>
<tr>
<td>T-MACH-107685</td>
<td>Exercises for Materials Characterization</td>
<td>2 CR</td>
<td>Gibmeier, Schneider</td>
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</table>

**Competence Certificate**

Oral exams: duration approx. 5 min. per credit point.

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

**Competence Goal**

As part of a major field a specific subdomain of mechanical engineering is made accessible in breadth and depth. Students gain comprehensive knowledge in the core subjects and detailed knowledge in the supplementary subjects of the selected subdomain. They are able to generate new (scientific) solutions within this subdomain.

The specific learning outcomes are defined by the respective coordinator of the major field.

**Prerequisites**

None

**Content**

The comprehensive topic of the major field are the thermodynamical and kinetic basics of materials science that the students acquire within the compulsory parts (8 credit points). Moreover, there is a supplementary area of materials science and engineering which offers different subjects according to the students’ interests.

**Annotation**

The module Materials Science and Engineering consists of 16 credit points in the master’s program. Within the compulsory parts, at least 8 credits are to be chosen. Within the supplementary area, the students can select from a broad variation of courses.

**Workload**

The work load is about 480 hours in the Master of Science program, whereof the presence time is 82 h.

**Learning type**

Within the compulsory parts of the major field Materials Science and Engineering the students choose from a small number of lectures and tutorials (obligatory).

Within the supplementary area students can choose not only lectures and tutorials but also lab courses and seminars.
### Module: Major Field: Mechatronics (SP 31) [M-MACH-102614]

**Responsible:** Prof. Dr. Veit Hagenmeyer  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- Specialization / Specialization: General Mechanical Engineering (Major Fields) 
- Specialization / Specialization: Energy- and Environment Engineering (Major Field) 
- Specialization / Specialization: Vehicle Technology (Major Field) 
- Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field (p)) 
- Specialization / Specialization: Product Development and Engineering Design (Major Field) 
- Specialization / Specialization: Production Technology (Major Field) 
- Specialization / Specialization: Theoretical Mechanical Engineering (Major Field)

**Credits:** 16  
**Grading scale:** Grade to a tenth  
**Recurrence:** Each term  
**Duration:** 2 terms  
**Language:** German/English  
**Level:** 4  
**Version:** 7

**Election notes**  
In the core area of Major Field at least 8 ECTS have to be chosen.

#### Election block: Mechatronics (K) (at least 8 credits)

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Module Name</th>
<th>Credits</th>
<th>Grading</th>
<th>Responsible</th>
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</thead>
<tbody>
<tr>
<td>T-MACH-105314</td>
<td>Computational Intelligence</td>
<td>4 CR</td>
<td>Mikut, Reinartz, Reischl</td>
<td></td>
</tr>
<tr>
<td>T-MACH-105694</td>
<td>Data Analytics for Engineers</td>
<td>5 CR</td>
<td>Meisenbacher, Mikut, Reischl</td>
<td></td>
</tr>
<tr>
<td>T-MACH-100535</td>
<td>Introduction into Mechatronics</td>
<td>6 CR</td>
<td>Böhland, Reischl</td>
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<tr>
<td>T-MACH-105209</td>
<td>Introduction into the Multi-Body Dynamics</td>
<td>5 CR</td>
<td>Seemann</td>
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<tr>
<td>T-MACH-105218</td>
<td>Automotive Vision</td>
<td>6 CR</td>
<td>Lauer, Stiller</td>
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<tr>
<td>T-MACH-105539</td>
<td>Modern Control Concepts I</td>
<td>4 CR</td>
<td>Groell, Matthes</td>
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<tr>
<td>T-MACH-105367</td>
<td>Behaviour Generation for Vehicles</td>
<td>6 CR</td>
<td>Naumann, Werling</td>
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</table>

#### Election block: Mechatronics (E) (at most 9 credits)

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Module Name</th>
<th>Credits</th>
<th>Grading</th>
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</thead>
<tbody>
<tr>
<td>T-MACH-102150</td>
<td>BUS-Controls</td>
<td>4 CR</td>
<td>Becker, Geimer</td>
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<tr>
<td>T-MACH-105212</td>
<td>CAE-Workshop</td>
<td>4 CR</td>
<td>Albers, Matthesien</td>
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<tr>
<td>T-MACH-111193</td>
<td>Data Driven Engineering 1: Machine Learning for Dynamical Systems</td>
<td>4 CR</td>
<td>Bauer</td>
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<tr>
<td>T-MACH-111373</td>
<td>Data Driven Engineering 2: Advanced Topics</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105317</td>
<td>Digital Control</td>
<td>4 CR</td>
<td>Knoop</td>
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<tr>
<td>T-MACH-111260</td>
<td>Dynamics of Electro-Mechanical Systems</td>
<td>5 CR</td>
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<tr>
<td>T-MACH-105514</td>
<td>Experimental Dynamics</td>
<td>5 CR</td>
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<tr>
<td>T-ETIT-100784</td>
<td>Hybrid and Electric Vehicles</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105187</td>
<td>IT-Fundamentals of Logistics</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-108957</td>
<td>Mathematical Fundamentals of Numerical Mechanics</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105294</td>
<td>Mathematical Methods of Vibration Theory</td>
<td>6 CR</td>
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<td>T-MACH-105210</td>
<td>Machine Dynamics</td>
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<td>T-MACH-105224</td>
<td>Machine Dynamics II</td>
<td>4 CR</td>
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<td>T-INFO-101266</td>
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<td>6 CR</td>
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<tr>
<td>T-MACH-105334</td>
<td>Mechanics in Microtechnology</td>
<td>4 CR</td>
<td>Greiner, Gruber</td>
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<tr>
<td>T-MACH-105335</td>
<td>Measurement II</td>
<td>4 CR</td>
<td>Stiller</td>
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<tr>
<td>T-MACH-105557</td>
<td>Microenergy Technologies</td>
<td>4 CR</td>
<td>Kohl</td>
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<tr>
<td>T-MACH-102152</td>
<td>Novel Actuators and Sensors</td>
<td>4 CR</td>
<td>Kohl, Sommer</td>
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<tr>
<td>T-MACH-111249</td>
<td>Optical Measuring Systems</td>
<td>4 CR</td>
<td>Sieber</td>
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<tr>
<td>T-MACH-105442</td>
<td>Intellectual Property Rights and Strategies in Industrial Companies</td>
<td>4 CR</td>
<td>Albers, Matthesien, Zacharias</td>
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<tr>
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<td>Laboratory Production Metrology</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105347</td>
<td>Project Management in Global Product Engineering Structures</td>
<td>4 CR</td>
<td>Albers, Gutzmer, Matthesien</td>
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</tbody>
</table>
## Competence Certificate

Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

## Competence Goal

The topic mechatronics offers a broad, multidisciplinary body of knowledge. The graduates are qualified to solve essential mechatronic questions. In particular the following disciplines are covered by the major mechatronics:

- Mechanics and fluidics
- Electronics
- Information processing
- Automation.

Students of the topic mechatronics know the future-oriented procedures. They are able to individually and creatively solve interdisciplinary questions and learn to effectively combine tools from the individual disciplines.

## Prerequisites

none

## Content

See brick courses.

## Workload

The work load is about 480 hours, corresponding to 16 credit points.

## Learning type

Lecture, tutorial.
### 9.39 Module: Major Field: Medical Technology (SP 32) [M-MACH-102615]

**Responsible:** apl. Prof. Dr. Christian Pylatiuk  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
Specialization / Specialization: General Mechanical Engineering (Major Fields)  
Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)  
Specialization / Specialization: Product Development and Engineering Design (Major Field)

<table>
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<tr>
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<th>Grading scale</th>
<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
<th>Level</th>
<th>Version</th>
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<tr>
<td>16</td>
<td>Grade to a tenth</td>
<td>Each term</td>
<td>2 terms</td>
<td>German/English</td>
<td>4</td>
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</table>

**Election notes**  
In the core area of Major Field at least 8 ECTS have to be chosen.

**Election block: Medical Technology (K) (at least 8 credits)**

<table>
<thead>
<tr>
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<th>Grade</th>
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<td>3</td>
<td>CR</td>
<td>Nahm</td>
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<tr>
<td>T-MACH-100966</td>
<td>BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I</td>
<td>4</td>
<td>CR</td>
<td>Guber</td>
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<tr>
<td>T-MACH-100967</td>
<td>BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II</td>
<td>4</td>
<td>CR</td>
<td>Guber</td>
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<tr>
<td>T-MACH-100968</td>
<td>BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III</td>
<td>4</td>
<td>CR</td>
<td>Guber</td>
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<tr>
<td>T-MACH-105314</td>
<td>Computational Intelligence</td>
<td>4</td>
<td>CR</td>
<td>Mikut, Reinartz, Reischl</td>
</tr>
<tr>
<td>T-MACH-105694</td>
<td>Data Analytics for Engineers</td>
<td>5</td>
<td>CR</td>
<td>Meisenbacher, Mikut, Reischl</td>
</tr>
<tr>
<td>T-MACH-100535</td>
<td>Introduction into Mechatronics</td>
<td>6</td>
<td>CR</td>
<td>Böhland, Reischl</td>
</tr>
<tr>
<td>T-MACH-105235</td>
<td>Principles of Medicine for Engineers</td>
<td>4</td>
<td>CR</td>
<td>Pylatiuk</td>
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</table>

**Election block: Medical Technology (E) (at most 8 credits)**

<table>
<thead>
<tr>
<th>Code</th>
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<th>Credits</th>
<th>Grade</th>
<th>Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-MACH-105238</td>
<td>Actuators and Sensors in Nanotechnology</td>
<td>4</td>
<td>CR</td>
<td>Kohl</td>
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<tr>
<td>T-GEISTSOZ-103287</td>
<td>Anatomy/Sports Medicine I</td>
<td>3</td>
<td>CR</td>
<td>Sell</td>
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<tr>
<td>T-ETIT-101930</td>
<td>Medical Imaging Techniques I</td>
<td>3</td>
<td>CR</td>
<td>Dössel</td>
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<tr>
<td>T-ETIT-101931</td>
<td>Medical Imaging Techniques II</td>
<td>3</td>
<td>CR</td>
<td>Dössel</td>
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<tr>
<td>T-ETIT-101956</td>
<td>Bioelectric Signals</td>
<td>3</td>
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<td>T-ETIT-106973</td>
<td>Biomedical Measurement Techniques II</td>
<td>3</td>
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<td>Hölscher</td>
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<tr>
<td>T-MACH-105228</td>
<td>Organ Support Systems</td>
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<td>CR</td>
<td>Pylatiuk</td>
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<tr>
<td>T-MACH-105221</td>
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<td>Albers, Burkardt</td>
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<tr>
<td>T-MACH-105334</td>
<td>Mechanics in Microtechnology</td>
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<td>CR</td>
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<td>T-ETIT-101937</td>
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<tr>
<td>T-MACH-111249</td>
<td>Optical Measuring Systems</td>
<td>4</td>
<td>CR</td>
<td>Sieber</td>
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<tr>
<td>T-MACH-105442</td>
<td>Intellectual Property Rights and Strategies in Industrial Companies</td>
<td>4</td>
<td>CR</td>
<td>Albers, Matthesien, Zacharias</td>
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<tr>
<td>T-GEISTSOZ-103290</td>
<td>Physiology/Sports Medicine II</td>
<td>3</td>
<td>CR</td>
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<tr>
<td>T-MACH-102164</td>
<td>Practical Training in Basics of Microsystem Technology</td>
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<td>T-MACH-105457</td>
<td>Project Mikromanufacturing: Development and Manufacturing of Microsystems</td>
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<tr>
<td>T-MACH-105347</td>
<td>Project Management in Global Product Engineering Structures</td>
<td>4</td>
<td>CR</td>
<td>Albers, Gutzmer, Matthesien</td>
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<tr>
<td>T-MACH-110960</td>
<td>Project Internship Aditive Manufacturing: Development and Production of an Additive Component</td>
<td>4</td>
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<td>Zanger</td>
</tr>
</tbody>
</table>
Competence Certificate
In the core area of Major Field at least 8 ECTS have to be chosen.

Competence Goal
The 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 major know all relevant methods to design modern medical devices and have the ability to efficiently and creatively develop solutions for leading edge medical applications.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials
9 MODULES

9.40 Module: Major Field: Microactuators and Microsensors (SP 54) [M-MACH-102647]

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

Part of:
- Specialization / Specialization: General Mechanical Engineering (Major Fields)
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)
- Specialization / Specialization: Vehicle Technology (Major Field)
- Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)
- Specialization / Specialization: Product Development and Engineering Design (Major Field)
- Specialization / Specialization: Production Technology (Major Field)

Credits: 16
Grading scale: Grade to a tenth
Recurrence: Each term
Duration: 2 terms
Language: German/English
Level: 4
Version: 2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

<table>
<thead>
<tr>
<th>Elevation block: Microactuators and Microsensors (K) (at least 8 credits)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-MACH-101910 Microactuators</td>
</tr>
<tr>
<td>T-MACH-102152 Novel Actuators and Sensors</td>
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<table>
<thead>
<tr>
<th>Elevation block: Microactuators and Microsensors (E) (at most 11 credits)</th>
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<tbody>
<tr>
<td>T-MACH-105238 Actuators and Sensors in Nanotechnology</td>
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<tr>
<td>T-MACH-100966 BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I</td>
</tr>
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<td>T-MACH-111260 Dynamics of Electro-Mechanical Systems</td>
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<tr>
<td>T-MACH-105321 Introduction to Theory of Materials</td>
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<tr>
<td>T-MACH-102166 Fabrication Processes in Microsystems Technology</td>
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<td>T-MACH-105182 Introduction to Microsystem Technology I</td>
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<tr>
<td>T-MACH-105183 Introduction to Microsystem Technology II</td>
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<tr>
<td>T-MACH-105334 Mechanics in Microtechnology</td>
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<td>T-MACH-105557 Microenergy Technologies</td>
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<td>T-MACH-105303 Modelling of Microstructures</td>
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<td>T-MACH-105180 Nanotechnology for Engineers and Natural Scientists</td>
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<td>T-INFO-108014 Robotics I - Introduction to Robotics</td>
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<td>T-MACH-105555 System Integration in Micro- and Nanotechnology</td>
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<td>T-MACH-110272 System Integration in Micro- and Nanotechnology 2</td>
</tr>
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</table>

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The Students achieved the following competence goals:

- Knowledge of the principles of actuation and sensing including pros and cons
- Knowledge of the underlying concepts of materials science and technology on different lengths scales
- Explanation of layout and function of important actuators and sensors
- Calculation of important properties (time constants, forces, displacements, sensitivity, etc.)
- Development of a layout based on specifications

Prerequisites
none
Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lecture, exercise.
### 9.41 Module: Major Field: Microsystem Technology (SP 33) [M-MACH-102616]

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

**Part of:**  
- Specialization / Specialization: General Mechanical Engineering (Major Fields)  
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)  
- Specialization / Specialization: Vehicle Technology (Major Field)  
- Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field (p))  
- Specialization / Specialization: Product Development and Engineering Design (Major Field)  
- Specialization / Specialization: Production Technology (Major Field)

**Credits:** 16  
**Grading scale:** Grade to a tenth  
**Recurrence:** Each term  
**Duration:** 2 terms  
**Language:** German/English  
**Level:** 4  
**Version:** 1

**Election notes**  
In the core area of Major Field at least 8 ECTS have to be chosen.

<table>
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<td>Introduction to Microsystem Technology II</td>
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<td>Jouda, Korvink</td>
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**Election block: Microsystem Technology (E) (at most 10 credits)**

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<tr>
<td>T-MACH-105238</td>
<td>Actuators and Sensors in Nanotechnology</td>
<td>4 CR</td>
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<td>T-MACH-102176</td>
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<tr>
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<td>BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I</td>
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<td>T-MACH-102172</td>
<td>Bionics for Engineers and Natural Scientists</td>
<td>4 CR</td>
<td>Hölscher</td>
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<tr>
<td>T-MACH-102166</td>
<td>Fabrication Processes in Microsystem Technology</td>
<td>4 CR</td>
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<td>T-MACH-105334</td>
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<td>T-MACH-105557</td>
<td>Microenergy Technologies</td>
<td>4 CR</td>
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<td>T-MACH-101910</td>
<td>Microactuators</td>
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<tr>
<td>T-MACH-108383</td>
<td>Microsystem Simulation</td>
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<tr>
<td>T-MACH-105814</td>
<td>Microsystem product design for young entrepreneurs</td>
<td>6 CR</td>
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<td>T-MACH-108613</td>
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<td>Novel Actuators and Sensors</td>
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<td>T-MACH-105442</td>
<td>Intellectual Property Rights and Strategies in Industrial Companies</td>
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<td>T-MACH-102200</td>
<td>Polymers in MEMS C: Biopolymers and Bioplastics</td>
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<td>X-ray Optics</td>
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**Election block: Microsystem Technology (P) (at most 4 credits)**

<table>
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<tr>
<td>T-MACH-108407</td>
<td>NMR micro probe hardware conception and construction</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105556</td>
<td>Practical Course Polymers in MEMS</td>
<td>2 CR</td>
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<tr>
<td>T-MACH-102164</td>
<td>Practical Training in Basics of Microsystem Technology</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105782</td>
<td>Micro Magnetic Resonance</td>
<td>4 CR</td>
<td>Korvink, MacKinnon</td>
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</table>
Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
In this key area, attendees gain competence in the design, construction, production, and application of micro and nano systems. Microsystems comprise the smallest human-made components. These include sensors, actuators, and system components working together for form a more powerful whole. Micro and nano systems are the basis for numerous smart products, such as smart dust, smart buildings, the internet of things, smart consumer-ware, smart mobility, and smart production via industry 4.0 concepts.

The increasing control over morphology at the nano and microscale is enabling the bottom up construction of passive and active materials with ideal and unheard-of properties, embedded in the devices that can make use of these, and are therefore revolutionising the world of products and scientific instrumentation.

Prerequisites
none

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials
9.42 Module: Major Field: Mobile Machines (SP 34) [M-MACH-102630]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Specialization / Specialization: General Mechanical Engineering (Major Fields)
Specialization / Specialization: Vehicle Technology (Major Field (p))
Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)
Specialization / Specialization: Product Development and Engineering Design (Major Field)
Specialization / Specialization: Production Technology (Major Field)

**Credits:** 16

**Grading scale:** Grade to a tenth

**Recurrence:** Each term

**Duration:** 2 terms

**Language:** German/English

**Level:** 4

**Version:** 1

**Election notes**

In the core area of Major Field at least 8 ECTS have to be chosen.

### Mandatory

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<tr>
<th>Module ID</th>
<th>Title</th>
<th>Credits</th>
<th>Lecture</th>
<th>Exam</th>
<th>Supervisor(s)</th>
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### Election block: Mobile Machines (E) ()

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<th>Lecture</th>
<th>Exam</th>
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<td>T-MACH-105161</td>
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<td>T-MACH-102093</td>
<td>Fluid Power Systems</td>
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<td>T-MACH-105441</td>
<td>Development of Oil-Hydraulic Powertrain Systems</td>
<td>4</td>
<td>Ays</td>
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<td>T-MACH-105347</td>
<td>Project Management in Global Product Engineering Structures</td>
<td>4</td>
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<td>T-MACH-105172</td>
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<td>Tractors</td>
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<td>Combustion Engines I</td>
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<td>T-MACH-105367</td>
<td>Behaviour Generation for Vehicles</td>
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### Election block: Mobile Machines (Ü) ()

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<tr>
<th>Module ID</th>
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<th>Lecture</th>
<th>Exam</th>
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<tr>
<td>T-MACH-108889</td>
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<td>T-MACH-108888</td>
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### Competence Certificate

Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

### Competence Goal

The student

- knows and understands the basic structure of the machines,
- masters the basic skills to develop the selected machines

### Prerequisites

None
Content

- Introduction of the required components and machines
- Basics of the structure of the whole system
- Practical insight in the development techniques

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type

- Research-oriented teaching
- lectures
- exercises
Module: Major Field: Modeling and Simulation in Dynamics (SP 61) [M-MACH-104434]

**Responsible:** Prof. Dr.-Ing. Wolfgang Seemann  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
Specialization / Specialization: General Mechanical Engineering (Major Fields)  
Specialization / Specialization: Energy- and Environment Engineering (Major Field)  
Specialization / Specialization: Vehicle Technology (Major Field)  
Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)  
Specialization / Specialization: Product Development and Engineering Design (Major Field)  
Specialization / Specialization: Production Technology (Major Field)  
Specialization / Specialization: Theoretical Mechanical Engineering (Major Field (p))

**Credits**  
16

**Grading scale**  
Grade to a tenth

**Recurrence**  
Each term

**Duration**  
2 terms

**Language**  
German/English

**Level**  
4

**Version**  
3

**Election notes**  
In the core area of each Major Field at least 8 ECTS have to be chosen.

<table>
<thead>
<tr>
<th>Election block: Modeling and Simulation in Dynamics (K) (at least 8 credits)</th>
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<tr>
<td>T-MACH-105209</td>
<td>Introduction into the Multi-Body Dynamics</td>
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<td>T-MACH-105210</td>
<td>Machine Dynamics</td>
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<td>T-MACH-105293</td>
<td>Mathematical Methods in Dynamics</td>
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<td>T-MACH-105226</td>
<td>Dynamics of the Automotive Drive Train</td>
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<td>T-MACH-105290</td>
<td>Vibration Theory</td>
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<td>T-MACH-105308</td>
<td>Atomistic Simulations and Molecular Dynamics</td>
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<td>T-MACH-111260</td>
<td>Dynamics of Electro-Mechanical Systems</td>
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<td>T-MACH-105514</td>
<td>Experimental Dynamics</td>
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<td>T-MACH-110834</td>
<td>Contact Mechanics for Dynamic Systems</td>
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<td>T-MACH-105224</td>
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<td>T-MACH-105294</td>
<td>Mathematical Methods of Vibration Theory</td>
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<td>T-MACH-105349</td>
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<td>Computational Vehicle Dynamics</td>
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<td>T-MACH-105384</td>
<td>Computerized Multibody Dynamics</td>
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<tr>
<td>T-MACH-105172</td>
<td>Simulation of Coupled Systems</td>
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</table>

**Election block: Modeling and Simulation in Dynamics (E) ()**

| T-MACH-108888 | Simulation of Coupled Systems - Advance | 0 CR | Geimer, Xiang |

**Competence Certificate**  
Oral exams: duration approx. 5 minutes per credit point.  
Amount, type and scope of the success control can vary according to individual choice.

**Competence Goal**  
The module provides modeling competences and continues thus the compulsory courses in dynamics. To this end analytical methods for the modeling and examination of dynamical systems are presented. The simulation of the systems enables the students to do simulation studies in typical applications in dynamical systems of mechanical engineering to be able to evaluate and interpret the results.

**Prerequisites**  
none
Content
This module deals with procedure, methods and applications for mechanical dynamical systems. Subjects are different methods to describe kinematics of multibody systems and to derive the equations of motion for such systems. Solutions of the equations of motion are obtained analytically by mathematical methods or approximately by numerical integration. Applications range from industrial systems like machines and cars down to atomistic simulation.

Workload
The work load is about 480 hours, corresponding to 16 credit points. 1 LP = 30 working hours.

Learning type
Lectures, Tutorials
Module: Major Field: Modeling and Simulation in Energy- and Fluid Engineering (SP 27) [M-MACH-102612]

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

Part of:
- Specialization / Specialization: General Mechanical Engineering (Major Fields)
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)
- Specialization / Specialization: Vehicle Technology (Major Field)
- Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)
- Specialization / Specialization: Product Development and Engineering Design (Major Field)

Credits: 16
Grading scale: Grade to a tenth
Recurrence: Each term
Duration: 2 terms
Language: German/English
Level: 4
Version: 2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Modeling and Simulation in Energy- and Fluid Engineering (K) (at least 8 credits)

T-MACH-105396  Modeling of Thermodynamical Processes  6 CR  Maas, Schießl
T-MACH-105339  Numerical Simulation of Reacting Two Phase Flows  4 CR  Koch
T-MACH-105338  Numerical Fluid Mechanics  4 CR  Magagnato

Election block: Modeling and Simulation in Energy- and Fluid Engineering (E) (at most 8 credits)

T-MACH-105407  CFD for Power Engineering  4 CR  Otic
T-MACH-105313  CFD-Lab Using OpenFOAM  4 CR  Koch
T-MACH-111193  Data Driven Engineering 1: Machine Learning for Dynamical Systems  4 CR  Bauer
T-MACH-111373  Data Driven Engineering 2: Advanced Topics  4 CR  Bauer
T-MACH-105533  Gasdynamics  4 CR  Magagnato
T-MACH-105419  Mathematical Models and Methods in Combustion Theory  4 CR  Bykov
T-MACH-105167  Analysis Tools for Combustion Diagnostics  4 CR  Pfeil
T-MACH-105420  Numerical Simulation of Multi-Phase Flows  4 CR  Wörner
T-MACH-105397  Numerical Simulation of Turbulent Flows  4 CR  Grötzbach
T-MACH-105421  Reduction Methods for the Modeling and the Simulation of Combustion Processes  4 CR  Bykov
T-MACH-111396  Smoothed Particle Hydrodynamics (SPH) in Computational Fluid Dynamics  4 CR  Koch
T-MACH-105422  Flows with Chemical Reactions  4 CR  Class
T-MACH-105403  Flows and Heat Transfer in Energy Technology  4 CR  Cheng
T-MACH-105456  Ten Lectures on Turbulence  4 CR  Otic
T-MACH-106372  Thermal-Fluid-Dynamics  4 CR  Ruck
T-MACH-102149  Virtual Reality Practical Course  4 CR  Ovtcharova

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
After completing the students can:
- formulate the governing equations for specific systems in energy and fluid mechanics.
- explain the different numerical schemes applied to solve the system of equations.
- use frequently applied simulation tools in a more efficient and successful way.

Prerequisites
None
Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials
### Module: Major Field: Nuclear Energy (SP 21) [M-MACH-102608]

**Responsible:** Prof. Dr.-Ing. Xu Cheng  
**Organisation:** KIT Department of Mechanical Engineering  

**Part of:**  
Specialization / Specialization: General Mechanical Engineering (Major Fields)  
Specialization / Specialization: Energy- and Environment Engineering (Major Field)  
Specialization / Specialization: Theoretical Mechanical Engineering (Major Field)

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<th>Duration</th>
<th>Language</th>
<th>Level</th>
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<td>Each term</td>
<td>2 terms</td>
<td>German/English</td>
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**Election notes**  
In the core area of Major Field at least 8 ECTS have to be chosen.

**Election block: Nuclear Energy (K) (at least 8 credits)**

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<td>Introduction to Nuclear Energy</td>
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<td>T-MACH-105402</td>
<td>Nuclear Power Plant Technology</td>
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**Election block: Nuclear Energy (E) (at most 8 credits)**

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<td>Fundamentals of reactor safety for the operation and dismantling of nuclear power plants</td>
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<td>Innovative Nuclear Systems</td>
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<td>Introduction to Neutron Cross Section Theory and Nuclear Data Generation</td>
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<td>Reactor Safety I: Fundamentals</td>
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<td>Flows and Heat Transfer in Energy Technology</td>
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**Competence Certificate**  
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**  
Students acquire the basic and advanced knowledge of nuclear technology and are able to apply the assimilated knowledge in practice and to analyze and solve by themselves important questions in the nuclear energy field.  
The courses of this module are built on three levels. With the overview lecture "Introduction into Nuclear Power", the students acquire broad basic knowledge of nuclear energy and are able to further study in-depth courses in various disciplines, namely thermal-hydraulics, reactor physics and materials science. As a result, students will understand the important processes of nuclear technology, such as control, heat transport and material behavior in a nuclear reactor. The properties of various nuclear systems, especially nuclear power plants, are available for study on the third level of the lectures. The students will possess then the ability to compare and analyze different nuclear systems.

**Prerequisites**  
None

**Content**  
See brick courses.

**Workload**  
The work load is about 480 hours, corresponding to 16 credit points.
Learning type
Lectures, Tutorials
9.46 Module: Major Field: Polymer Engineering (SP 36) [M-MACH-102632]

**Module Handbook, valid from Winter Term 2021/2022**

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Specialization / Specialization: General Mechanical Engineering (Major Fields)
Specialization / Specialization: Energy- and Environment Engineering (Major Field)
Specialization / Specialization: Vehicle Technology (Major Field)
Specialization / Specialization: Product Development and Engineering Design (Major Field)
Specialization / Specialization: Production Technology (Major Field)
Specialization / Specialization: Materials and Structures for High Performance Systems (Major Field)

**Credits:** 16
**Grading scale:** Grade to a tenth
**Recurrence:** Each term
**Duration:** 2 terms
**Language:** German/English
**Level:** 4
**Version:** 2

**Election notes**
In the core area of each Major Field at least 8 ECTS have to be chosen.

**Election block: Polymer Engineering (K) (at least 8 credits)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
<th>Grading</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-MACH-102137</td>
<td>Polymer Engineering I</td>
<td>4 CR</td>
<td>Elsner, Liebig</td>
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<tr>
<td>T-MACH-102138</td>
<td>Polymer Engineering II</td>
<td>4 CR</td>
<td>Elsner, Liebig</td>
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**Election block: Polymer Engineering (E) (at most 8 credits)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
<th>Grading</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-MACH-105237</td>
<td>Vehicle Lightweight Design - Strategies, Concepts, Materials</td>
<td>4 CR</td>
<td>Henning</td>
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</tr>
<tr>
<td>T-MACH-105535</td>
<td>Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies</td>
<td>4 CR</td>
<td>Henning</td>
<td></td>
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<tr>
<td>T-MACH-105330</td>
<td>Design with Plastics</td>
<td>4 CR</td>
<td>Liedel</td>
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<tr>
<td>T-MACH-110954</td>
<td>Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice</td>
<td>4 CR</td>
<td>Kärger, Liebig</td>
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<tr>
<td>T-MACH-105333</td>
<td>Mechanics and Strength of Polymers</td>
<td>4 CR</td>
<td>von Bernstorff</td>
<td></td>
</tr>
<tr>
<td>T-MACH-111431</td>
<td>Programming in CAE-Applications</td>
<td>4 CR</td>
<td>Kärger</td>
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<tr>
<td>T-MACH-105971</td>
<td>Simulation of the process chain of continuously fiber reinforced composite structure</td>
<td>4 CR</td>
<td>Kärger</td>
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<tr>
<td>T-MACH-105970</td>
<td>Structural Analysis of Composite Laminates</td>
<td>4 CR</td>
<td>Kärger</td>
<td></td>
</tr>
<tr>
<td>T-MACH-110937</td>
<td>Materials Recycling and Sustainability</td>
<td>4 CR</td>
<td>Elsner, Liebig</td>
<td></td>
</tr>
</tbody>
</table>

**Competence Certificate**

Oral exams: duration approx. 5 min. per credit point.
However, amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**
The students...

- are able to choose polymers for applications in mechanical engineering in target-oriented way and are able to justify their selection.
- are able to describe and compare production processes for polymers and PMCs exemplarily.
- are able to describe the mechanical behaviour of polymers and PMC based on scientific theories, principles and methods.
- are able to solve tasks in the field of polymer engineering and proceed adequate to the situation.
- are able to integrate intra-modular knowledge at the solution of given problems.
- have the ability to develop polymer parts in a constructive way under consideration of technical and economic conditions.

**Prerequisites**
None

**Content**
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.
Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials
### 9.47 Module: Major Field: Power Plant Technology (SP 23) [M-MACH-102610]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- Specialization / Specialization: General Mechanical Engineering (Major Fields)  
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)  
- Specialization / Specialization: Product Development and Engineering Design (Major Field)

#### Credits 16  
**Grading scale:** Grade to a tenth  
**Recurrence:** Each term  
**Duration:** 2 terms  
**Language:** German/English  
**Level:** 4  
**Version:** 4

**Election notes**  
In the core area of Major Field at least 8 ECTS have to be chosen.

#### Election block: Power Plant Technology (K) (at least 8 credits)

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Module Name</th>
<th>Credits</th>
<th>Grade</th>
<th>Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-MACH-105410</td>
<td>Coal Fired Power Plants</td>
<td>4 CR</td>
<td></td>
<td>Schulenberg</td>
</tr>
<tr>
<td>T-MACH-105444</td>
<td>Combined Cycle Power Plants</td>
<td>4 CR</td>
<td></td>
<td>Schulenberg</td>
</tr>
<tr>
<td>T-MACH-105326</td>
<td>Hydraulic Fluid Machinery</td>
<td>8 CR</td>
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<td>Pritz</td>
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<tr>
<td>T-MACH-105402</td>
<td>Nuclear Power Plant Technology</td>
<td>4 CR</td>
<td></td>
<td>Badea, Cheng, Schulenberg</td>
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<tr>
<td>T-MACH-105363</td>
<td>Thermal Turbomachines I</td>
<td>6 CR</td>
<td></td>
<td>Bauer</td>
</tr>
<tr>
<td>T-MACH-105364</td>
<td>Thermal Turbomachines II</td>
<td>6 CR</td>
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#### Election block: Power Plant Technology (E) (at most 5 credits)

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Module Name</th>
<th>Credits</th>
<th>Grade</th>
<th>Responsible</th>
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</thead>
<tbody>
<tr>
<td>T-MACH-105310</td>
<td>Design of Highly Stresses Components</td>
<td>4 CR</td>
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<td>Aktaa</td>
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<tr>
<td>T-MACH-111193</td>
<td>Data Driven Engineering 1: Machine Learning for Dynamical Systems</td>
<td>4 CR</td>
<td></td>
<td>Bauer</td>
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<tr>
<td>T-MACH-105525</td>
<td>Introduction to Nuclear Energy</td>
<td>4 CR</td>
<td></td>
<td>Cheng</td>
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<tr>
<td>T-MACH-105411</td>
<td>Fusion Technology A</td>
<td>4 CR</td>
<td></td>
<td>Steiglitz</td>
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<tr>
<td>T-MACH-105213</td>
<td>Fundamentals of Combustion I</td>
<td>4 CR</td>
<td></td>
<td>Maas</td>
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<tr>
<td>T-MACH-105386</td>
<td>Occupational Safety and Environmental Protection</td>
<td>4 CR</td>
<td>von Kiparski</td>
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<tr>
<td>T-MACH-105404</td>
<td>Innovative Nuclear Systems</td>
<td>4 CR</td>
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<td>Cheng</td>
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<tr>
<td>T-MACH-105414</td>
<td>Cooling of Thermally High Loaded Gas Turbine Components</td>
<td>4 CR</td>
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<td>Bauer, Schulz</td>
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<tr>
<td>T-MACH-105338</td>
<td>Numerical Fluid Mechanics</td>
<td>4 CR</td>
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<td>Magagnato</td>
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<tr>
<td>T-MACH-105442</td>
<td>Intellectual Property Rights and Strategies in Industrial Companies</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Zacharias</td>
<td></td>
</tr>
<tr>
<td>T-MACH-105347</td>
<td>Project Management in Global Product Engineering Structures</td>
<td>4 CR</td>
<td>Albers, Gutzmer, Matthiesen</td>
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<tr>
<td>T-MACH-107447</td>
<td>Reliability Engineering 1</td>
<td>3 CR</td>
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<td>Konnov</td>
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<tr>
<td>T-MACH-105354</td>
<td>Fatigue of Metallic Materials</td>
<td>4 CR</td>
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<td>Guth</td>
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<tr>
<td>T-MACH-105445</td>
<td>Simulator Exercises Combined Cycle Power Plants</td>
<td>2 CR</td>
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<tr>
<td>T-MACH-111382</td>
<td>Technical Acoustics</td>
<td>4 CR</td>
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<td>Pantle, Walter</td>
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<tr>
<td>T-MACH-105225</td>
<td>Thermal Solar Energy</td>
<td>4 CR</td>
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<td>Steiglitz</td>
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<tr>
<td>T-MACH-106372</td>
<td>Thermal-Fluid-Dynamics</td>
<td>4 CR</td>
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<td>Ruck</td>
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<tr>
<td>T-MACH-105365</td>
<td>Turbine and Compressor Design</td>
<td>4 CR</td>
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<td>Bauer</td>
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<tr>
<td>T-MACH-105416</td>
<td>Hydrogen Technologies</td>
<td>4 CR</td>
<td></td>
<td>Jordan</td>
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<tr>
<td>T-MACH-105234</td>
<td>Windpower</td>
<td>4 CR</td>
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<td>Lewald</td>
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<tr>
<td>T-MACH-105406</td>
<td>Two-Phase Flow and Heat Transfer</td>
<td>4 CR</td>
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<td>Schulenberg, Wörner</td>
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#### Election block: Power Plant Technology (P) (at most 4 credits)

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Module Name</th>
<th>Credits</th>
<th>Grade</th>
<th>Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-MACH-105313</td>
<td>CFD-Lab Using OpenFOAM</td>
<td>4 CR</td>
<td></td>
<td>Koch</td>
</tr>
<tr>
<td>T-MACH-105515</td>
<td>Introduction to Numerical Fluid Dynamics</td>
<td>4 CR</td>
<td></td>
<td>Pritz</td>
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</tbody>
</table>

*This item will not influence the grade calculation of this parent.*
T-MACH-105331 Laboratory Exercise in Energy Technology  
This item will not influence the grade calculation of this parent.  
4 CR  Bauer, Maas, Wirbser

T-MACH-106707 Workshop on Computer-based Flow Measurement Techniques  
This item will not influence the grade calculation of this parent.  
4 CR  Bauer

T-MACH-111396 Smoothed Particle Hydrodynamics (SPH) in Computational Fluid Dynamics  
4 CR  Koch

**Competence Certificate**

Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**

After completion of SP 23 students are able:

- to name the different types of centralized and distributed power plants,
- to explain the operational principle of well-established power plants as well as of power plants based on renewable energies,
- to predict the electric, respectively thermal efficiency of power plants,
- to assess the economics of power plants,
- to highlight the environmental impact of conventional power plants and of renewable energies,
- to assess the availability, operational safety and flexibility of different types of power plants,
- to develop advanced power plants based on thermodynamic, fluid mechanical and other basics.

**Prerequisites**

None

**Content**

See brick courses.

**Workload**

The work load is about 480 hours, corresponding to 16 credit points.

**Learning type**

Lectures, tutorials.
**9.48 Module: Major Field: Powertrain Systems (SP 02) [M-MACH-102599]**

**Responsible:** Prof. Dr.-Ing. Albert Albers  
**Organisation:** KIT Department of Mechanical Engineering

### Credits

<table>
<thead>
<tr>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
<th>Level</th>
<th>Version</th>
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<tbody>
<tr>
<td>16</td>
<td>Grade to a tenth</td>
<td>Each term</td>
<td>2 terms</td>
<td>German/English</td>
<td>4</td>
<td>3</td>
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</table>

**Election notes**

In the core area of each Major Field at least 8 ECTS have to be chosen.

#### Election block: Powertrain Systems (K) (at least 8 credits)

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Grades</th>
<th>Responsible</th>
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</thead>
<tbody>
<tr>
<td>T-MACH-105307</td>
<td>Drive Train of Mobile Machines</td>
<td>4 CR</td>
<td>Geimer, Wydra</td>
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<tr>
<td>T-MACH-105233</td>
<td>Powertrain Systems Technology A: Automotive Systems</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Ott</td>
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<tr>
<td>T-MACH-105216</td>
<td>Powertrain Systems Technology B: Stationary Machinery</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Ott</td>
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<tr>
<td>T-MACH-105226</td>
<td>Dynamics of the Automotive Drive Train</td>
<td>5 CR</td>
<td>Fidlin</td>
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#### Election block: Powertrain Systems (E) (at most 8 credits)

<table>
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<th>Code</th>
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<th>Credits</th>
<th>Grades</th>
<th>Responsible</th>
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<tbody>
<tr>
<td>T-MACH-105215</td>
<td>Applied Tribology in Industrial Product Development</td>
<td>4 CR</td>
<td>Albers, Lorentz, Matthiesen</td>
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<tr>
<td>T-MACH-110958</td>
<td>Design and Optimization of Conventional and Electrified Automotive Transmissions</td>
<td>4 CR</td>
<td>Albers, Faust</td>
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<tr>
<td>T-MACH-111398</td>
<td>Design of Fuel Cell Systems</td>
<td>4 CR</td>
<td>Haußmann</td>
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<tr>
<td>T-MACH-102150</td>
<td>BUS-Controls</td>
<td>4 CR</td>
<td>Becker, Geimer</td>
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<tr>
<td>T-MACH-105209</td>
<td>Introduction into the Multi-Body Dynamics</td>
<td>5 CR</td>
<td>Seemann</td>
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<tr>
<td>T-MACH-105151</td>
<td>Energy Efficient Intralogistic Systems</td>
<td>4 CR</td>
<td>Braun, Schönung</td>
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<tr>
<td>T-ETIT-100784</td>
<td>Hybrid and Electric Vehicles</td>
<td>4 CR</td>
<td>Becker</td>
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<tr>
<td>T-MACH-105187</td>
<td>IT-Fundamentals of Logistics</td>
<td>4 CR</td>
<td>Thomas</td>
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<tr>
<td>T-MACH-105231</td>
<td>Leadership and Management Development</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Floch</td>
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<tr>
<td>T-MACH-105210</td>
<td>Machine Dynamics</td>
<td>5 CR</td>
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<tr>
<td>T-MACH-105224</td>
<td>Machine Dynamics II</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-102152</td>
<td>Novel Actuators and Sensors</td>
<td>4 CR</td>
<td>Kohl, Sommer</td>
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<tr>
<td>T-MACH-105442</td>
<td>Intellectual Property Rights and Strategies in Industrial Companies</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Zacharias</td>
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<tr>
<td>T-MACH-110984</td>
<td>Production Technology for E-Mobility</td>
<td>4 CR</td>
<td>Fleischer, Ruhlard</td>
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<tr>
<td>T-MACH-105441</td>
<td>Development of Oil-Hydraulic Powertrain Systems</td>
<td>4 CR</td>
<td>Ays, Geerling</td>
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</tr>
<tr>
<td>T-MACH-105347</td>
<td>Project Management in Global Product Engineering Structures</td>
<td>4 CR</td>
<td>Albers, Gutzmer, Matthiesen</td>
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<tr>
<td>T-MACH-105185</td>
<td>Control Technology</td>
<td>4 CR</td>
<td>Gönnheimer</td>
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<tr>
<td>T-MACH-105696</td>
<td>Strategic Product Development - Identification of Potentials of Innovative Products</td>
<td>3 CR</td>
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<tr>
<td>T-MACH-110396</td>
<td>Strategic Product Development - Identification of Potentials of Innovative Products - Case Study</td>
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<tr>
<td>T-MACH-105358</td>
<td>Sustainable Product Engineering</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105531</td>
<td>Tribology</td>
<td>8 CR</td>
<td>Dienwiebel, Scherge</td>
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<tr>
<td>T-MACH-102194</td>
<td>Combustion Engines I</td>
<td>4 CR</td>
<td>Koch, Kubach</td>
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<tr>
<td>T-MACH-102140</td>
<td>Failure of Structural Materials: Deformation and Fracture</td>
<td>4 CR</td>
<td>Gumbsch, Weygand</td>
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<tr>
<td>T-MACH-102148</td>
<td>Gear Cutting Technology</td>
<td>4 CR</td>
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**Election block: Powertrain Systems (Ü) ()**
Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The students know and understand the technical and physical basics and systematic connections of drive systems. The lecture deals vehicle drive systems as well as drive systems for stationary and mobile work machines.

They are able to choose, describe and use complex dimensioning- and design methods for drive systems under consideration of the interactions of the system.

Prerequisites
none

Content
See brick courses

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials
### 9.49 Module: Major Field: Production Technology (SP 39) [M-MACH-102618]

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

**Part of:**  
Specialization / Specialization: General Mechanical Engineering (Major Fields)  
Specialization / Specialization: Vehicle Technology (Major Field)  
Specialization / Specialization: Product Development and Engineering Design (Major Field)  
Specialization / Specialization: Production Technology (Major Field (p))

**Credits:** 16  
**Grading scale:** Grade to a tenth  
**Recurrence:** Each term  
**Duration:** 2 terms  
**Language:** German/English  
**Level:** 4  
**Version:** 5

**Election notes**  
In the core area of Major Field at least 8 ECTS have to be chosen.

#### Election block: Production Technology (K) (at least 8 credits)

<table>
<thead>
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<th>Course Description</th>
<th>Credits</th>
<th>Grade</th>
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<tbody>
<tr>
<td>T-MACH-108844</td>
<td>Automated Manufacturing Systems</td>
<td>8 CR</td>
<td>Fleischer</td>
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<tr>
<td>T-MACH-102105</td>
<td>Manufacturing Technology</td>
<td>8 CR</td>
<td>Schulze, Zanger</td>
</tr>
<tr>
<td>T-MACH-110337</td>
<td>Global Production and Logistics</td>
<td>8 CR</td>
<td>Furmans, Lanza</td>
</tr>
<tr>
<td>T-MACH-108849</td>
<td>Integrated Production Planning in the Age of Industry 4.0</td>
<td>8 CR</td>
<td>Lanza</td>
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<tr>
<td>T-MACH-110962</td>
<td>Machine Tools and High-Precision Manufacturing Systems</td>
<td>8 CR</td>
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#### Election block: Production Technology (E) (at most 8 credits)

<table>
<thead>
<tr>
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<th>Grade</th>
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<tbody>
<tr>
<td>T-MACH-110176</td>
<td>Digitalization from Production to the Customer in the Optical Industry</td>
<td>4 CR</td>
<td>Wawerla</td>
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<td>T-MACH-102159</td>
<td>Elements and Systems of Technical Logistics</td>
<td>4 CR</td>
<td>Fischer, Mittwollen</td>
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<td>T-MACH-108946</td>
<td>Elements and Systems of Technical Logistics - Project</td>
<td>2 CR</td>
<td>Fischer, Mittwollen</td>
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<td>T-MACH-105151</td>
<td>Energy Efficient Intralogistic Systems</td>
<td>4 CR</td>
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<td>4 CR</td>
<td>Wilhelm</td>
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<td>T-MACH-111003</td>
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<td>T-MACH-110991</td>
<td>Global Production</td>
<td>4 CR</td>
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<td>T-MACH-109919</td>
<td>Basics of Technical Logistics I</td>
<td>4 CR</td>
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<td>Basics of Technical Logistics II</td>
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<td>Human-oriented Productivity Management: Personnel Management</td>
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<td>Introduction to Industrial Production Economics</td>
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<td>Integrative Strategies in Production and Development of High Performance Cars</td>
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<td>International Production Engineering A</td>
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<td>T-MACH-110335</td>
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<td>Warehousing and Distribution Systems</td>
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<td>Leadership and Management Development</td>
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<td>T-MACH-110954</td>
<td>Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice</td>
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<td>Kärger, Liebig</td>
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<td>Learning Factory “Global Production”</td>
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<td>T-MACH-105189</td>
<td>Mathematical Models and Methods for Production Systems</td>
<td>6 CR</td>
<td>Baumann, Furmans</td>
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<td>Intellectual Property Rights and Strategies in Industrial Companies</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Zacharias</td>
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<td>Planning of Assembly Systems</td>
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<td>Production Planning and Control</td>
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<td>Production Technology for E-Mobility</td>
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<td>Productivity Management in Production Systems</td>
<td>4 CR</td>
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<td>Project Mikromanufacturing: Development and Manufacturing of Microsystems</td>
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<td>Development of Oil-Hydraulic Powertrain Systems</td>
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<td>Quality Management</td>
<td>4 CR</td>
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<td>T-MACH-105170</td>
<td>Welding Technology</td>
<td>4 CR</td>
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<td>T-MACH-108737</td>
<td>Seminar Data-Mining in Production</td>
<td>3 CR</td>
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<td>T-MACH-105185</td>
<td>Control Technology</td>
<td>4 CR</td>
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<td>T-MACH-105362</td>
<td>Technology of Steel Components</td>
<td>4 CR</td>
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<td>T-MACH-105177</td>
<td>Metal Forming</td>
<td>4 CR</td>
<td>Herlan</td>
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<td>T-MACH-102148</td>
<td>Gear Cutting Technology</td>
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<td>Klaiber</td>
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<td>T-MACH-110937</td>
<td>Materials Recycling and Sustainability</td>
<td>4 CR</td>
<td>Elsner, Liebig</td>
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**Election block: Production Technology (P) (at most 4 credits)**

<table>
<thead>
<tr>
<th>Code</th>
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<th>Credits</th>
<th>Lecturer</th>
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<tbody>
<tr>
<td>T-MACH-102099</td>
<td>Experimental Lab Class in Welding Technology, in Groups</td>
<td>4 CR</td>
<td>Dietrich</td>
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<tr>
<td>T-MACH-102154</td>
<td>Laboratory Laser Materials Processing</td>
<td>4 CR</td>
<td>Schneider</td>
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<tr>
<td>T-MACH-108878</td>
<td>Laboratory Production Metrology</td>
<td>4 CR</td>
<td>Häfner</td>
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<tr>
<td>T-MACH-105346</td>
<td>Production Techniques Laboratory</td>
<td>4 CR</td>
<td>Deml, Fleischer, Furmans, Ovtcharova</td>
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<tr>
<td>T-MACH-110960</td>
<td>Project Internship Additive Manufacturing: Development and Production of an Additive Component</td>
<td>4 CR</td>
<td>Zanger</td>
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<tr>
<td>T-MACH-110981</td>
<td>Tutorial Global Production</td>
<td>1 CR</td>
<td>Lanza</td>
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</table>

**Competence Certificate**

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

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

**Competence Goal**

The students ...

- are able to analyze new situations and choose methods of production science target-oriented based on the analyses, as well as justifying their selection.
- are able to describe and compare complex production processes exemplarily.
- are able to generate new solutions in the field of production science under consideration of scientific theories, principles and methods.
- are able to solve tasks in the field of production science team oriented and proceed responsible and adequate to the situation.
- are able to integrate the results of others at the solution of given problems.
- have the ability to state results in written form developed in a team, and are able to interpret and present them with self-chosen methods.
- are able to identify, dissect and develop further systems and processes and apply given sets of criteria under consideration of technical, economic and social conditions.

**Prerequisites**

None

**Content**

Within this module the students will get to know and learn about production science. Manifold lectures and excursions as part of several lectures provide specific insights into the field of production science.

**Workload**

The work load is about 480 hours, corresponding to 16 credit points.

**Learning type**

Lectures, seminars, workshops, excursions
M 9.50 Module: Major Field: Rail System Technology (SP 50) [M-MACH-102641]

Responsibie: Prof. Dr.-Ing. Marcus Geimer  
Prof. Dr.-Ing. Peter Gratzfeld  
Organisation: KIT Department of Mechanical Engineering

Part of:  
Specialization / Specialization: General Mechanical Engineering (Major Fields)  
Specialization / Specialization: Vehicle Technology (Major Field (p))  
Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)  
Specialization / Specialization: Product Development and Engineering Design (Major Field)

Credits 16  
Grading scale Grade to a tenth  
Recurrence Each term  
Duration 2 terms  
Language German/English  
Level 4  
Version 3

Election notes  
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>T-MACH-106424</td>
<td>Rail System Technology</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105353</td>
<td>Rail Vehicle Technology</td>
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Election block: Rail System Technology (E) (at most 10 credits)

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<tr>
<td>T-MACH-105540</td>
<td>Railways in the Transportation Market</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-102121</td>
<td>Electric Rail Vehicles</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105237</td>
<td>Vehicle Lightweight Design - Strategies, Concepts, Materials</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105218</td>
<td>Automotive Vision</td>
<td>6 CR</td>
</tr>
<tr>
<td>T-MACH-105535</td>
<td>Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105350</td>
<td>Computational Vehicle Dynamics</td>
<td>4 CR</td>
</tr>
<tr>
<td>T-MACH-108692</td>
<td>Seminar for Rail System Technology</td>
<td>3 CR</td>
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</table>

Competence Certificate  
Oral exams: duration approx. 5 min. per credit point.  
However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal

- The students understand relations and interdependencies between rail vehicles, infrastructure and operation in a rail system.
- Based on operating requirements and legal framework they derive the requirements concerning a capable infrastructure and suitable concepts of rail vehicles.
- They recognize the impact of alignment, understand the important function of the wheel-rail-contact and estimate the impact of driving dynamics on the operating program.
- They evaluate the impact of operating concepts on safety and capacity of a rail system.
- They know the infrastructure to provide power supply to rail vehicles with different drive systems.
- The students learn the role of rail vehicles and understand their classification. They understand the basic structure and know the functions of the main systems. They understand the overall tasks of vehicle system technology.
- They learn functions and requirements of car bodies and judge advantages and disadvantages of design principles. They know the functions of the car body's interfaces.
- They know about the basics of running dynamics and bogies.
- The students learn about advantages and disadvantages of different types of traction drives and judge, which one fits best for each application.
- They understand brakes from a vehicular and an operational point of view. They assess the fitness of different brake systems.
- They know the basic setup of train control management system and understand the most important functions.
- They specify and define suitable vehicle concepts based on requirements for modern rail vehicles.
- Supplementary lectures present further major aspects of a rail system.

Prerequisites

None
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
8. Vehicle system technology: structure and main systems of rail vehicles
9. Car body: functions, requirements, design principles, crash elements, coupling, doors and windows
10. Bogies: forces, running gears, bogies, Jakobs-bogies, active components, connection to car body, wheel arrangement
11. 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
12. Brakes: basics, principles (wheel brakes, rail brakes, blending), brake control (requirements and operation modes, pneumatic brake, electropneumatic brake, emergency brake, parking brake)
13. Train control management system: definition of TCMS, bus systems, components, network architectures, examples, future trends
15. Further contents in supplementary lectures

Annotation
A bibliography is available for download (Ilias-platform).

Workload

- Total effort at 16 ECTS (M.Sc.): about 480 hours
- Regular attendance: 84 hours
- Self-study: 84 hours
- Exam and preparation: 312 hours

Learning type
Lectures in the core part.
Lectures and seminars are offered in the supplementary part.
**9.51 Module: Major Field: Reliability in Mechanical Engineering (SP 49) [M-MACH-102602]**

**Responsible:** Prof. Dr. Peter Gumbsch  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- Specialization / Specialization: General Mechanical Engineering (Major Fields)  
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)  
- Specialization / Specialization: Vehicle Technology (Major Field)  
- Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)  
- Specialization / Specialization: Product Development and Engineering Design (Major Field)  
- Specialization / Specialization: Production Technology (Major Field)  
- Specialization / Specialization: Theoretical Mechanical Engineering (Major Field)  
- Specialization / Specialization: Materials and Structures for High Performance Systems (Major Field (p))

### Credits

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<th>Duration</th>
<th>Language</th>
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<td>Each term</td>
<td>2 terms</td>
<td>German/English</td>
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**Election notes**  
In the core area of Major Field at least 8 ECTS have to be chosen.

#### Mandatory

<table>
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<tr>
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<th>Title</th>
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<tr>
<td>T-MACH-102139</td>
<td>Failure of Structural Materials: Fatigue and Creep</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-102140</td>
<td>Failure of Structural Materials: Deformation and Fracture</td>
<td>4 CR</td>
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#### Election block: Reliability in Mechanical Engineering (E) ()

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<tbody>
<tr>
<td>T-MACH-105308</td>
<td>Atomistic Simulations and Molecular Dynamics</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105310</td>
<td>Design of Highly Stresses Components</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105321</td>
<td>Introduction to Theory of Materials</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105984</td>
<td>Fatigue of Welded Components and Structures</td>
<td>3 CR</td>
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<tr>
<td>T-MACH-105334</td>
<td>Mechanics in Microtechnology</td>
<td>4 CR</td>
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<td>T-MACH-105516</td>
<td>Multi-Scale Plasticity</td>
<td>4 CR</td>
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<td>T-MACH-105724</td>
<td>Failure Analysis</td>
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<td>T-MACH-105354</td>
<td>Fatigue of Metallic Materials</td>
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<td>T-MACH-105369</td>
<td>Materials Modelling: Dislocation Based Plasticity</td>
<td>4 CR</td>
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<td>T-MACH-100532</td>
<td>Scientific Computing for Engineers</td>
<td>4 CR</td>
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<td>T-MACH-110378</td>
<td>Mathematical Methods in Micromechanics</td>
<td>5 CR</td>
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<td>T-MACH-105971</td>
<td>Simulation of the process chain of continuously fiber reinforced composite structure</td>
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<td>T-MACH-110954</td>
<td>Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice</td>
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<td>Structural Analysis of Composite Laminates</td>
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#### Election block: Reliability in Mechanical Engineering (P) (at most 4 credits)

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<td>T-MACH-105392</td>
<td>FEM Workshop - Constitutive Laws</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105417</td>
<td>Finite Element Workshop</td>
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**Election block: Reliability in Mechanical Engineering (Ü) ()**

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<tr>
<td>T-MACH-109304</td>
<td>Excercises - Fatigue of Welded Components and Structures</td>
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<tr>
<td>T-MACH-110379</td>
<td>Tutorial Mathematical Methods in Micromechanics</td>
<td>1 CR</td>
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**Competence Certificate**  
Oral exams: duration approx. 5 min. per credit point.  
However, amount, type and scope of the success control can vary according to the individually choice.
Competence Goal
After attending the core subjects "failure of structural materials: fatigue and creep" (T-MACH-102139) and "failure of structural materials: deformation and fracture"(T-MACH-102140) the students will gain the following skills:

- They have the basic understanding of mechanical processes to explain the relationship between externally applied load and materials strength.
- They can explain the foundation of linear elastic fracture mechanics and is able to determine if this concept can be applied to a failure by fracture.
- They can describe the main empirical materials models for fatigue and creep as well as for deformation and fracture and can apply them.
- They have the physical understanding to describe and explain phenomena of failure.
- They can use statistical approaches for reliability predictions.
- They can use its acquired skills, to select and develop materials for specific applications.

The additional competence goals depend on which further lectures are selected and are explicitly described there.

Prerequisites
None

Content
In addition to the core subjects "failure of structural materials: fatigue and creep" (T-MACH-102139) and "failure of structural materials: deformation and fracture" (T-MACH-102140), the student has to choose two more lectures, which deal with specific problems of reliability of components and systems in mechanical engineering.

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

Recommendation
preliminary knowledge in mathematics, mechanics and materials science

Annotation
The module Reliability in Mechanical Engineering consists of 16 credit points in the master's program. Within that module, the students have to pass bricks T-MACH-105531 and T-MACH-109303 from the core area (8 credit points) and can select from a broad variation of courses within the supplementary area.

In the core area of the major field Materials Science and Engineering the students have to pass bricks T-MACH-102139 and T-MACH-102140 (obligatory).

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials, Lab Courses and Seminars.
## Module: Major Field: Robotics (SP 40) [M-MACH-102633]

### Responsible
apl. Prof. Dr. Ralf Mikut

### Organisation
KIT Department of Mechanical Engineering

### Part of:
- Specialization / Specialization: General Mechanical Engineering (Major Fields)
- Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field (p))
- Specialization / Specialization: Product Development and Engineering Design (Major Field)
- Specialization / Specialization: Production Technology (Major Field)
- Specialization / Specialization: Theoretical Mechanical Engineering (Major Field)

<table>
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<th>Credits</th>
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<td>2 terms</td>
<td>German/English</td>
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### Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

### Election block: Robotics (K) (at least 8 credits)

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<th>Module Code</th>
<th>Course Title</th>
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<tr>
<td>T-MACH-105314</td>
<td>Computational Intelligence</td>
<td>4 CR</td>
<td>Mikut, Reinartz, Reischl</td>
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<tr>
<td>T-MACH-105694</td>
<td>Data Analytics for Engineers</td>
<td>5 CR</td>
<td>Meisenbacher, Mikut, Reischl</td>
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<td>T-MACH-100535</td>
<td>Introduction into Mechatronics</td>
<td>6 CR</td>
<td>Böhland, Reischl</td>
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<td>T-MACH-105218</td>
<td>Automotive Vision</td>
<td>6 CR</td>
<td>Lauer, Stiller</td>
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<td>T-INFO-108014</td>
<td>Robotics I - Introduction to Robotics</td>
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<td>T-INFO-105723</td>
<td>Robotics II: Humanoid Robotics</td>
<td>3 CR</td>
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<td>T-MACH-105367</td>
<td>Behaviour Generation for Vehicles</td>
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<td>Naumann, Werling</td>
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### Election block: Robotics (E) (at most 8 credits)

<table>
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<tr>
<th>Module Code</th>
<th>Course Title</th>
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<tr>
<td>T-MACH-105216</td>
<td>Powertrain Systems Technology B: Stationary Machinery</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Ott</td>
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<tr>
<td>T-MACH-108844</td>
<td>Automated Manufacturing Systems</td>
<td>8 CR</td>
<td>Fleischer</td>
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<td>T-INFO-101351</td>
<td>Biologically Inspired Robots</td>
<td>3 CR</td>
<td>Dillmann, Rönnau</td>
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<td>T-MACH-105317</td>
<td>Digital Control</td>
<td>4 CR</td>
<td>Knoop</td>
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<td>T-INFO-105142</td>
<td>Humanoid Robots - Practical Course</td>
<td>3 CR</td>
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<td>T-MACH-105378</td>
<td>Cognitive Automobiles - Laboratory</td>
<td>6 CR</td>
<td>Kitt, Lauer, Stiller</td>
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<tr>
<td>T-MACH-105221</td>
<td>Lightweight Engineering Design</td>
<td>4 CR</td>
<td>Albers, Burkardt</td>
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<td>T-INFO-101377</td>
<td>Localization of Mobile Agents</td>
<td>6 CR</td>
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<td>T-MACH-105223</td>
<td>Machine Vision</td>
<td>8 CR</td>
<td>Lauer, Stiller</td>
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<tr>
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<td>Mathematical Models and Methods for Production Systems</td>
<td>6 CR</td>
<td>Baumann, Furmans</td>
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<tr>
<td>T-MACH-105335</td>
<td>Measurement II</td>
<td>4 CR</td>
<td>Stiller</td>
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<td>T-MACH-105539</td>
<td>Modern Control Concepts I</td>
<td>4 CR</td>
<td>Groell, Matthes</td>
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<tr>
<td>T-MACH-102152</td>
<td>Novel Actuators and Sensors</td>
<td>4 CR</td>
<td>Kohl, Sommer</td>
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<td>T-MACH-111249</td>
<td>Optical Measuring Systems</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105442</td>
<td>Intellectual Property Rights and Strategies in Industrial Companies</td>
<td>4 CR</td>
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<td>T-MACH-105384</td>
<td>Computerized Multibody Dynamics</td>
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<td>T-INFO-101352</td>
<td>Robotics III - Sensors in Robotics</td>
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<td>Laboratory Production Metrology</td>
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<td>T-MACH-105341</td>
<td>Lab Computer-Aided Methods for Measurement and Control</td>
<td>4 CR</td>
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<td>T-MACH-105990</td>
<td>Simulation of Optical Systems</td>
<td>4 CR</td>
<td>Sieber</td>
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<td>T-MACH-105185</td>
<td>Control Technology</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105358</td>
<td>Sustainable Product Engineering</td>
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<tr>
<td>T-MACH-105555</td>
<td>System Integration in Micro- and Nanotechnology</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-110272</td>
<td>System Integration in Micro- and Nanotechnology 2</td>
<td>4 CR</td>
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</table>
Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The Robotics offers extensive knowledge to develop, design and manufacture future intelligent robots. The following scientific disciplines are covered during the major Robotics:

- Control systems and control theory
- Actuators and sensors
- Mathematical and descriptive methods

The students of the major Robotics have the essential skills necessary to develop future robotic systems for modern applications.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lecture, tutorial.
Module: Major Field: Technical Ceramics and Powder Materials (SP 43) [M-MACH-102619]

**Responsible:** Prof. Dr. Michael Hoffmann

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- Specialization / Specialization: General Mechanical Engineering (Major Fields)
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)
- Specialization / Specialization: Vehicle Technology (Major Field)
- Specialization / Specialization: Product Development and Engineering Design (Major Field)
- Specialization / Specialization: Materials and Structures for High Performance Systems (Major Field)

**Credits:** 16

**Grading scale:** Grade to a tenth

**Recurrence:** Each term

**Duration:** 2 terms

**Language:** German/English

**Level:** 4

**Version:** 1

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**Election notes**
In the core area of Major Field at least 8 ECTS have to be chosen.

**Election block: Technical Ceramics and Powder Materials (K) (at least 8 credits)**

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<thead>
<tr>
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<th>Instructor(s)</th>
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<tbody>
<tr>
<td>T-MACH-102111</td>
<td>Principles of Ceramic and Powder Metallurgy Processing</td>
<td>4 CR</td>
<td>Schell</td>
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<tr>
<td>T-MACH-100287</td>
<td>Introduction to Ceramics</td>
<td>6 CR</td>
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<tr>
<td>T-MACH-106722</td>
<td>Ceramic Matrix Composites</td>
<td>4 CR</td>
<td>Koch</td>
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<tr>
<td>T-MACH-102179</td>
<td>Structural Ceramics</td>
<td>4 CR</td>
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**Election block: Technical Ceramics and Powder Materials (E) (at most 8 credits)**

<table>
<thead>
<tr>
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<td>Bionic Inspired Reinforced Composites</td>
<td>4 CR</td>
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<td>T-MACH-102182</td>
<td>Ceramic Processing Technology</td>
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<td>T-MACH-102157</td>
<td>High Performance Powder Metallurgy Materials</td>
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<td>T-MACH-102170</td>
<td>Structural and Phase Analysis</td>
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<td>T-MACH-102140</td>
<td>Failure of Structural Materials: Deformation and Fracture</td>
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<td>Gumbsch, Weygand</td>
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**Election block: Technical Ceramics and Powder Materials (P) (at most 4 credits)**

<table>
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<tr>
<td>T-MACH-105178</td>
<td>Practical Course Technical Ceramics</td>
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**Competence Certificate**

Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**
The students acquire comprehensive and fundamental knowledge of preparation, processing and characterization of technical powders, their consolidation by various shaping techniques and the densification by sintering. They know the manifold possibilities of microstructural design of powdermetallurgical parts and are able to discuss the microstructure property relationships.

**Prerequisites**
None

**Content**
See brick courses.

**Workload**
The work load is about 480 hours, corresponding to 16 credit points.

**Learning type**
Lectures, Tutorials
Module: Major Field: Technical Logistics (SP 44) [M-MACH-102640]

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

Part of: Specialization / Specialization: General Mechanical Engineering (Major Fields)
Specialization / Specialization: Product Development and Engineering Design (Major Field)
Specialization / Specialization: Production Technology (Major Field)

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<th>Duration</th>
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<th>Level</th>
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<td>2 terms</td>
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Mandatory

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<td>T-MACH-109919</td>
<td>Basics of Technical Logistics I</td>
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<td>Mittwollen, Oellerich</td>
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<tr>
<td>T-MACH-109920</td>
<td>Basics of Technical Logistics II</td>
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Elective block: Technical Logistics (E) ()

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<tr>
<td>T-MACH-102160</td>
<td>Selected Applications of Technical Logistics</td>
<td>4</td>
<td>CR</td>
<td>Milushev, Mittwollen</td>
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<tr>
<td>T-MACH-108945</td>
<td>Selected Applications of Technical Logistics - Project</td>
<td>2</td>
<td>CR</td>
<td>Milushev, Mittwollen</td>
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<tr>
<td>T-MACH-102159</td>
<td>Elements and Systems of Technical Logistics</td>
<td>4</td>
<td>CR</td>
<td>Fischer, Mittwollen</td>
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<tr>
<td>T-MACH-108946</td>
<td>Elements and Systems of Technical Logistics - Project</td>
<td>2</td>
<td>CR</td>
<td>Fischer, Mittwollen</td>
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<tr>
<td>T-MACH-105151</td>
<td>Energy Efficient Intralogistic Systems</td>
<td>4</td>
<td>CR</td>
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<td>Global Logistics</td>
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<td>T-MACH-105187</td>
<td>IT-Fundamentals of Logistics</td>
<td>4</td>
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<td>T-MACH-105174</td>
<td>Warehousing and Distribution Systems</td>
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<td>CR</td>
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<td>T-MACH-105175</td>
<td>Airport Logistics</td>
<td>3</td>
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<td>T-MACH-105171</td>
<td>Safety Engineering</td>
<td>4</td>
<td>CR</td>
<td>Kany</td>
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<tr>
<td>T-MACH-108844</td>
<td>Automated Manufacturing Systems</td>
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<td>Cognitive Automobiles - Laboratory</td>
<td>6</td>
<td>CR</td>
<td>Kitt, Lauer, Stiller</td>
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<td>T-MACH-102107</td>
<td>Quality Management</td>
<td>4</td>
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<td>T-MACH-105367</td>
<td>Behaviour Generation for Vehicles</td>
<td>6</td>
<td>CR</td>
<td>Naumann, Werling</td>
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Competence Certificate
see brick courses

Competence Goal
Students are able to:
- Describe main functional elements of technical logistics,
- Determine the main parameters necessary for functionality,
- Combine those functional elements to solve material handling tasks appropriately, and
- Evaluate resulting material handling installations.

Prerequisites
None

Content
The emphasis module Technical Logistics provides in-depth basics on the main topics of technical logistics. The module focuses on technical characteristics of material handling technology. To gain a deeper understanding, the course is accompanied by exercises.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures and practices; self-study
### 9.55 Module: Major Field: Thermal Turbomachines (SP 46) [M-MACH-102636]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
Specialization / Specialization: General Mechanical Engineering (Major Fields)  
Specialization / Specialization: Energy- and Environment Engineering (Major Field)  
Specialization / Specialization: Vehicle Technology (Major Field)  
Specialization / Specialization: Theoretical Mechanical Engineering (Major Field)  
Specialization / Specialization: Materials and Structures for High Performance Systems (Major Field)

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<td>Each term</td>
<td>2 terms</td>
<td>German/English</td>
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**Election notes**  
In the core area of Major Field at least 8 ECTS have to be chosen.

#### Mandatory

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<th>Course Title</th>
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<tr>
<td>T-MACH-105363</td>
<td>Thermal Turbomachines I</td>
<td>6 CR</td>
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<tr>
<td>T-MACH-105364</td>
<td>Thermal Turbomachines II</td>
<td>6 CR</td>
<td>Each term</td>
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#### Election block: Thermal Turbomachines (E) ()

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<td>T-MACH-111193</td>
<td>Data Driven Engineering 1: Machine Learning for Dynamical Systems</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-111373</td>
<td>Data Driven Engineering 2: Advanced Topics</td>
<td>4 CR</td>
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<td>T-MACH-105512</td>
<td>Experimental Fluid Mechanics</td>
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<td>T-MACH-105444</td>
<td>Combined Cycle Power Plants</td>
<td>4 CR</td>
<td>Schulenberg</td>
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<td>T-MACH-105533</td>
<td>Gasdynamics</td>
<td>4 CR</td>
<td>Magagnato</td>
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<td>T-MACH-105221</td>
<td>Lightweight Engineering Design</td>
<td>4 CR</td>
<td>Albers, Burkardt</td>
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<td>T-MACH-105414</td>
<td>Cooling of Thermally High Loaded Gas Turbine Components</td>
<td>4 CR</td>
<td>Bauer, Schulz</td>
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<td>Machine Dynamics</td>
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<td>T-MACH-105224</td>
<td>Machine Dynamics II</td>
<td>4 CR</td>
<td>Proppe</td>
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<td>T-MACH-105339</td>
<td>Numerical Simulation of Reacting Two Phase Flows</td>
<td>4 CR</td>
<td>Koch</td>
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<tr>
<td>T-MACH-105442</td>
<td>Intellectual Property Rights and Strategies in Industrial Companies</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Zacharias</td>
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<td>Reliability Engineering 1</td>
<td>3 CR</td>
<td>Konnov</td>
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<td>T-MACH-105354</td>
<td>Fatigue of Metallic Materials</td>
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<td>Guth</td>
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<td>T-MACH-105171</td>
<td>Safety Engineering</td>
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<td>T-MACH-105290</td>
<td>Vibration Theory</td>
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<td>Turbine and Compressor Design</td>
<td>4 CR</td>
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<td>Turbo Jet Engines</td>
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<td>Failure of Structural Materials: Fatigue and Creep</td>
<td>4 CR</td>
<td>Gruber, Gumbsch</td>
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<td>Failure of Structural Materials: Deformation and Fracture</td>
<td>4 CR</td>
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<tr>
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<td>Vortex Dynamics</td>
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#### Election block: Thermal Turbomachines (P) (at most 4 credits)

<table>
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<th>Course Title</th>
<th>Credits</th>
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<td>CFD-Lab Using OpenFOAM</td>
<td>4 CR</td>
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<td>T-MACH-106707</td>
<td>Workshop on Computer-based Flow Measurement Techniques</td>
<td>4 CR</td>
<td>Bauer</td>
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<tr>
<td>T-MACH-105445</td>
<td>Simulator Exercises Combined Cycle Power Plants</td>
<td>2 CR</td>
<td>Schulenberg</td>
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<tr>
<td>T-MACH-111396</td>
<td>Smoothed Particle Hydrodynamics (SPH) in Computational Fluid Dynamics</td>
<td>4 CR</td>
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</table>

**Competence Certificate**

Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.
Competence Goal
After completion of SP 46 students are able to:

- identify and quantify the specific requirements of different applications in the fields of energy technology, aeronautics, car and motor technology and process technology on thermal turbo machines,
- apply the basics of thermodynamics, fluid mechanics and of other generic disciplines to analyse and design turbo machines and their components,
- explain the governing processes in turbo machines such as compression, combustion and expansion,
- Recognise and exploit the potentials to further improve the economics and environmental friendliness of turbo machines, their components and in their interaction with the overarching systems, like power plant or airplane,
- Explain the operational principle of turbo machines and the related generics.

Prerequisites
None

Content
Thermal turbo machines are driving generators of power plants to generate electric energy. In aeronautics turbofan, turboprop and turboshift engines are the dominating propulsion systems for airplanes and helicopters due to their high specific power-to-weight ratio and efficiency. Turbochargers are providing increased power and efficiency to internal combustion engines. Turbocompressors are used in multiple applications in chemical and process industry. In the major subject “Thermal Turbo Machines” students learn to apply their basic knowledge in thermodynamics, fluid mechanics, technical mechanics and other generic disciplines to analyse and develop challenging applications.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials
Module: Major Field: Tribology (SP 47) [M-MACH-102637]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- Specialization / Specialization: General Mechanical Engineering (Major Fields)
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)
- Specialization / Specialization: Vehicle Technology (Major Field)
- Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)
- Specialization / Specialization: Product Development and Engineering Design (Major Field)
- Specialization / Specialization: Production Technology (Major Field)
- Specialization / Specialization: Theoretical Mechanical Engineering (Major Field)
- Specialization / Specialization: Materials and Structures for High Performance Systems (Major Field)

**Credits:** 16

**Grading scale:** Grade to a tenth

**Recurrence:** Each term

**Duration:** 2 terms

**Language:** German/English

**Level:** 4

**Version:** 1

**Election notes**
In the core area of Major Field at least 8 ECTS have to be chosen.

**Mandatory**

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<td>T-MACH-109303</td>
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**Election block: Tribology (E) ()**

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<td>Powertrain Systems Technology A: Automotive Systems</td>
<td>4 CR</td>
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<td>Atomistic Simulations and Molecular Dynamics</td>
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<tr>
<td>T-MACH-102141</td>
<td>Constitution and Properties of Wearresistant Materials</td>
<td>4 CR</td>
<td>Ulrich</td>
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<tr>
<td>T-MACH-105786</td>
<td>Contact Mechanics</td>
<td>4 CR</td>
<td>Greiner</td>
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<tr>
<td>T-MACH-105180</td>
<td>Nanotechnology for Engineers and Natural Scientists</td>
<td>4 CR</td>
<td>Dienwiebel, Hölscner, Walheim</td>
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</table>

**Election block: Tribology (P) (at most 4 credits)**

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Title</th>
<th>Credits</th>
<th>Grade</th>
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<tbody>
<tr>
<td>T-MACH-102167</td>
<td>Nanotribology and -Mechanics</td>
<td>4 CR</td>
<td>Dienwiebel, Hölscner</td>
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<tr>
<td>T-MACH-102137</td>
<td>Polymer Engineering I</td>
<td>4 CR</td>
<td>Elsner, Liebig</td>
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<tr>
<td>T-MACH-105724</td>
<td>Failure Analysis</td>
<td>4 CR</td>
<td>Greiner, Schneider</td>
</tr>
<tr>
<td>T-MACH-102103</td>
<td>Superhard Thin Film Materials</td>
<td>4 CR</td>
<td>Ulrich</td>
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</table>

**Election notes**
This item will not influence the grade calculation of this parent.

**Election block: Tribology (P) (at most 4 credits)**

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Title</th>
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<th>Grade</th>
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<tbody>
<tr>
<td>T-MACH-105813</td>
<td>Practical Course &quot;Tribology&quot;</td>
<td>4 CR</td>
<td>Dienwiebel, Schneider</td>
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</table>

**Competence Certificate**
Oral exams: duration approx. 5 min. per credit point.

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

**Competence Goal**
After attending the core subject "tribology" (2181114) the students have the following skills:

- They can describe the fundamental friction and wear mechanisms, which occur in tribologically stressed systems.
- They can evaluate the friction and wear behavior of tribological systems.
- They can explain the effects of lubricants and their most important additives.
- They can identify suitable approaches to optimize tribological systems.
- They 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.
- They can 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.
- They can describe the most important surface-analytical methods and their physical principles for the characterization of tribologically stressed sliding surfaces.

The additional learning outcomes depend on which further lectures are selected and are explicitly described there.
Prerequisites
None

Content
In addition to the core subject “tribology” (bricks T-MACH-105531 and T-MACH-109303), the student has to choose two more lectures, which deal with specific problems of tribology, e.g. in the field of product development, simulation or materials selection.

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

Annotation
The module Tribology consists of 16 credit points in the master’s program. Within that module, the students have to pass bricks T-MACH-105531 and T-MACH-109303 from the core area (8 credit points) and can select from a broad variation of courses within the supplementary area.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
In the core area of the major field Materials Science and Engineering the students have to pass bricks T-MACH-105531 and T-MACH-109303 (obligatory).

Within the supplementary area students can choose not only lectures and tutorials but also lab courses and seminars.
### Module: Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics (SP 11) [M-MACH-102606]

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

### Part of:
- Specialization / Specialization: General Mechanical Engineering (Major Fields)  
- Specialization / Specialization: Vehicle Technology (Major Field)  
- Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)  
- Specialization / Specialization: Product Development and Engineering Design (Major Field)  
- Specialization / Specialization: Theoretical Mechanical Engineering (Major Field)

### Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

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<tr>
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<th>Duration</th>
<th>Language</th>
<th>Level</th>
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<td>Each term</td>
<td>2 terms</td>
<td>German/English</td>
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### Election block: Vehicle Dynamics, Vehicle Comfort and Acoustics (K) (at least 8 credits)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Instructed by</th>
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</thead>
<tbody>
<tr>
<td>T-MACH-105154</td>
<td>Vehicle Comfort and Acoustics I</td>
<td>4 CR</td>
<td>Gauterin</td>
</tr>
<tr>
<td>T-MACH-105155</td>
<td>Vehicle Comfort and Acoustics II</td>
<td>4 CR</td>
<td>Gauterin</td>
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### Election block: Vehicle Dynamics, Vehicle Comfort and Acoustics (E) (at most 11 credits)

<table>
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<th>Title</th>
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<tbody>
<tr>
<td>T-MACH-105233</td>
<td>Powertrain Systems Technology A: Automotive Systems</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Ott</td>
</tr>
<tr>
<td>T-MACH-108719</td>
<td>Designing with numerical methods in product development</td>
<td>4 CR</td>
<td>Schnack</td>
</tr>
<tr>
<td>T-MACH-105226</td>
<td>Dynamics of the Automotive Drive Train</td>
<td>5 CR</td>
<td>Fidlin</td>
</tr>
<tr>
<td>T-MACH-105152</td>
<td>Handling Characteristics of Motor Vehicles I</td>
<td>4 CR</td>
<td>Unrau</td>
</tr>
<tr>
<td>T-MACH-105153</td>
<td>Handling Characteristics of Motor Vehicles II</td>
<td>4 CR</td>
<td>Unrau</td>
</tr>
<tr>
<td>T-MACH-108374</td>
<td>Vehicle Ergonomics</td>
<td>4 CR</td>
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<td>T-MACH-105156</td>
<td>Vehicle Mechatronics I</td>
<td>4 CR</td>
<td>Ammon</td>
</tr>
<tr>
<td>T-MACH-105218</td>
<td>Automotive Vision</td>
<td>6 CR</td>
<td>Lauer, Stiller</td>
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<tr>
<td>T-MACH-102117</td>
<td>Automotive Engineering II</td>
<td>4 CR</td>
<td>Gauterin, Unrau</td>
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<tr>
<td>T-MACH-105375</td>
<td>Industrial Aerodynamics</td>
<td>4 CR</td>
<td>Breitling, Frohnapfel</td>
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<tr>
<td>T-MACH-105221</td>
<td>Lightweight Engineering Design</td>
<td>4 CR</td>
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<td>T-MACH-105539</td>
<td>Modern Control Concepts I</td>
<td>4 CR</td>
<td>Groell, Matthes</td>
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<td>T-MACH-108720</td>
<td>Numerical Mechanics for Industrial Applications</td>
<td>4 CR</td>
<td>Schnack</td>
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<td>T-MACH-110796</td>
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<td>Rhode</td>
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<td>T-MACH-105349</td>
<td>Computational Dynamics</td>
<td>4 CR</td>
<td>Proppe</td>
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<td>T-MACH-105350</td>
<td>Computational Vehicle Dynamics</td>
<td>4 CR</td>
<td>Proppe</td>
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<td>T-MACH-105384</td>
<td>Computerized Multibody Dynamics</td>
<td>4 CR</td>
<td>Seemann</td>
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<td>T-MACH-105367</td>
<td>Behaviour Generation for Vehicles</td>
<td>6 CR</td>
<td>Naumann, Werling</td>
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<tr>
<td>T-MACH-105443</td>
<td>Wave Propagation</td>
<td>4 CR</td>
<td>Seemann</td>
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<td>T-MACH-111382</td>
<td>Technical Acoustics</td>
<td>4 CR</td>
<td>Pantle, Walter</td>
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</tbody>
</table>

### Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

### Competence Goal
The student
- knows and understands the dynamic characteristics of vehicles, owing to the construction and design tokens,
- knows and understands especially the factors being relevant for comfort and acoustics,
- is capable of fundamentally evaluating and rating handling characteristics.

### Prerequisites
None
Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials
### Module: Major Field: Vehicle Technology (SP 12) [M-MACH-102607]

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

**Part of:**  
- Specialization / Specialization: General Mechanical Engineering (Major Fields)  
- Specialization / Specialization: Vehicle Technology (Major Field (p))  
- Specialization / Specialization: Product Development and Engineering Design (Major Field)

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<tr>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
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**Mandatory**

<table>
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<tbody>
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**Elective block: Automotive Technology (E) ()**

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Module Title</th>
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<tbody>
<tr>
<td>T-MACH-105655</td>
<td>Alternative Powertrain for Automobiles</td>
<td>4 CR</td>
<td>Noreikat</td>
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<tr>
<td>T-MACH-105233</td>
<td>Powertrain Systems Technology A: Automotive Systems</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Ott</td>
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<tr>
<td>T-MACH-110958</td>
<td>Design and Optimization of Conventional and Electrified Automotive Transmissions</td>
<td>4 CR</td>
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<td>T-MACH-108844</td>
<td>Automated Manufacturing Systems</td>
<td>8 CR</td>
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<td>T-MACH-111550</td>
<td>CO2-Neutral Combustion Engines and their Fuels I</td>
<td>4 CR</td>
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<td>T-MACH-111560</td>
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<td>T-MACH-108721</td>
<td>Designing with Composites</td>
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<td>Development of hybrid drivetrains</td>
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<td>T-MACH-105153</td>
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<td>4 CR</td>
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<td>Vehicle Lightweight Design - Strategies, Concepts, Materials</td>
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<td>Tires and Wheel Development for Passenger Cars</td>
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<td>Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies</td>
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<td>T-MACH-105044</td>
<td>Fundamentals of Catalytic Exhaust Gas Aftertreatment</td>
<td>4 CR</td>
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<td>Fundamentals for Design of Motor-Vehicle Bodies I</td>
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<td>T-MACH-102119</td>
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<td>Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice</td>
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<td>Numerical Mechanics for Industrial Applications</td>
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<td>T-MACH-105442</td>
<td>Intellectual Property Rights and Strategies in Industrial Companies</td>
<td>4 CR</td>
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<td>Production Technology for E-Mobility</td>
<td>4 CR</td>
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<td>Product, Process and Resource Integration in the Automotive Industry</td>
<td>4 CR</td>
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<td>Product- and Production-Concepts for Modern Automobiles</td>
<td>4 CR</td>
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<td>Project Workshop: Automotive Engineering</td>
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<td>Development of Oil-Hydraulic Powertrain Systems</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105347</td>
<td>Project Management in Global Product Engineering Structures</td>
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<td>Fundamentals of Combustion Engine Technology</td>
<td>5 CR</td>
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<td>4 CR</td>
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<td>Behaviour Generation for Vehicles</td>
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<td>4 CR</td>
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<td>Hydrogen and reFuels - Energy Conversion in Combustion Engines</td>
<td>4 CR</td>
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</table>

**Competence Certificate**

Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**

The student

- knows the most important components of a vehicle,
- knows and understands the functioning and the interaction of the individual components,
- knows the basics of dimensioning the components,
- knows and understands the procedures in automobile development,
- knows and understands the technical specifications at the development procedures,
- is aware of notable boundaries like legislation,
- is ready to analyze and judge vehicle concepts and to participate competently in the development of vehicles.

**Prerequisites**

None

**Content**

See brick courses.

**Workload**

The work load is about 480 hours, corresponding to 16 credit points.

**Learning type**

Lectures, tutorials.
Module: Major Field: Vibration Theory (SP 60) [M-MACH-104443]

9.59 Module: Major Field: Vibration Theory (SP 60) [M-MACH-104443]

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

Part of:
- Specialization / Specialization: General Mechanical Engineering (Major Fields)
- Specialization / Specialization: Energy- and Environment Engineering (Major Field)
- Specialization / Specialization: Vehicle Technology (Major Field)
- Specialization / Specialization: Mechatronics and Microsystems Technology (Major Field)
- Specialization / Specialization: Production Technology (Major Field)
- Specialization / Specialization: Theoretical Mechanical Engineering (Major Field (p))

Credits 16
Grading scale Grade to a tenth
Recurrence Each term
Duration 2 terms
Language German/English
Level 4
Version 2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Vibration Theory (K) (at least 8 credits)
- T-MACH-105290 Vibration Theory 5 CR Fidlin, Seemann
- T-MACH-105210 Machine Dynamics 5 CR Proppe
- T-MACH-105294 Mathematical Methods of Vibration Theory 6 CR Seemann
- T-MACH-105372 Theory of Stability 6 CR Fidlin

Election block: Vibration Theory (E) (at most 9 credits)
- T-MACH-105224 Machine Dynamics II 4 CR Proppe
- T-MACH-105443 Wave Propagation 4 CR Seemann
- T-MACH-105226 Dynamics of the Automotive Drive Train 5 CR Fidlin
- T-MACH-111260 Dynamics of Electro-Mechanical Systems 5 CR Fidlin
- T-MACH-105514 Experimental Dynamics 5 CR Fidlin
- T-MACH-105439 Introduction to Nonlinear Vibrations 7 CR Fidlin
- T-MACH-105154 Vehicle Comfort and Acoustics I 4 CR Gauterin
- T-MACH-105155 Vehicle Comfort and Acoustics II 4 CR Gauterin
- T-MACH-110834 Contact Mechanics for Dynamic Systems 4 CR Römer
- T-MACH-105349 Computational Dynamics 4 CR Proppe
- T-MACH-105373 Practical Training in Measurement of Vibrations 4 CR Fidlin

Competence Certificate
Oral exams: duration approx. 5 minutes per credit point.
Amount, type and scope of the success control can vary according to individual choice.

Competence Goal
The students know different methods which may be applied for the analysis of investigation of vibrations problems. They are able to treat one or multiple degrees of freedom systems as well as vibrating continua. The goal is to establish a chain from physical modeling via mathematical solution to an interpretation of the results. Based on the courses which are chosen the knowledge has emphasis on theoretical investigations, approximation methods or experimental methods and applications in automotive engineering.

Prerequisites
none

Workload
The work load is about 480 hours, corresponding to 16 credit points. 1 LP = 30 working hours

Learning type
Lectures, Tutorials
9.60 Module: Master's Thesis

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

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

### Competence Certificate

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

The maximal processing time of the master thesis takes six 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 KITGor habilitated members of the KIT Faculty of Mechanical Engineering and another examiner. Generally, one of the two examiners is the person who has assigned the thesis. If the examiners do not agree, the master thesis is graded by the examination board within this assessment; another expert can be appointed too. The master thesis has to be graded within a period of six weeks after the submission. The colloquium presentation must be held within 6 weeks after the submission of the master thesis. The presentation should last around 30 minutes and is followed by a scientific discussion with the present expert audience.

### 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.

### Prerequisites

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

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

### Modeled Conditions

The following conditions have to be fulfilled:

1. You need to earn at least 74 credits in the following fields:
   - Advanced Engineering Fundamentals
   - Specialization

### 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.
Module: Mathematical Methods (MSc-Modul 08, MM) [M-MACH-102594]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Advanced Engineering Fundamentals

<table>
<thead>
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<th>Credits</th>
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<th>Language</th>
<th>Level</th>
<th>Version</th>
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<td>Each term</td>
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**Election block: Mathematical Methods (1 item)**

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<tr>
<td>T-MACH-105293</td>
<td>Mathematical Methods in Dynamics</td>
<td>6 CR</td>
<td>Proppe</td>
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<tr>
<td>T-MACH-105294</td>
<td>Mathematical Methods of Vibration Theory</td>
<td>6 CR</td>
<td>Seemann</td>
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<tr>
<td>T-MACH-105295</td>
<td>Mathematical Methods in Fluid Mechanics</td>
<td>6 CR</td>
<td>Frohnapfel</td>
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<tr>
<td>T-MACH-105189</td>
<td>Mathematical Models and Methods for Production Systems</td>
<td>6 CR</td>
<td>Baumann, Furmans</td>
</tr>
<tr>
<td>T-MATH-102242</td>
<td>Numerical Mathematics for Students of Computer Science</td>
<td>6 CR</td>
<td>Rieder, Weiß, Wiener</td>
</tr>
<tr>
<td>T-MATH-109620</td>
<td>Probability Theory and Statistics</td>
<td>6 CR</td>
<td>Hug</td>
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<tr>
<td>T-MACH-110375</td>
<td>Mathematical Methods in Continuum Mechanics</td>
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<td>T-MACH-110378</td>
<td>Mathematical Methods in Micromechanics</td>
<td>5 CR</td>
<td>Böhlke</td>
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**Election block: Tutorial Mathematical Methods ()**

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<tr>
<td>T-MACH-110379</td>
<td>Tutorial Mathematical Methods in Micromechanics</td>
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</table>

**Competence Certificate**
written exam, duration 3 h

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

**Prerequisites**
none

**Content**
see chosen brick course.

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

**Learning type**
Lectures, Tutorials
Responsible: Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Marcus Geimer
Dr. Balazs Pritz
Prof. Dr.-Ing. Carsten Proppe

Organisation: KIT Department of Mechanical Engineering

Part of: Advanced Engineering Fundamentals

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</table>

Mandatory

| T-MACH-105297 | Modeling and Simulation | 7 CR | Furmans, Geimer, Pritz, Proppe |

Competence Certificate
written exam, 3 hours

Competence Goal
Students are able to explain models and simulations as part of many disciplines of mechanical engineering. They are able to reproduce the interdisciplinary aspects of typical modeling and simulation techniques in mechanical engineering. The students are proficient in simulation studies from problem formulation to modeling, simulation, verification and validation, ie:

- They are able to formulate the steps necessary to resolve problems arising in engineering, to create appropriate conceptual and mathematical models and to analyze them.

- They are able to develop and implement algorithms for the solution of mathematical models.

- They are able to perform comprehensive and interdisciplinary simulation studies to assess the simulation results and to critically evaluate the quality of the simulation results.

Prerequisites
none

Content
Introduction: Overview, concept formulation, simulation studies.

Time/event-discrete models, event-orientated/process orientated/transaction orientated view, typical model classes (operation/maintenance, storekeeping, loss-susceptible systems).


Time-continuous models with distributed parameters, description of systems by means of partial differential equations, model reduction, numerical solution procedures for partial differential equations.

Workload
Regular attendance: 42 hours
Self-study: 168 hours

Learning type
Lecture and Tutorials
### Module: Product Development - Dimensioning of Components (MSc-Modul 06, PE-B) [M-MACH-102593]

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

#### Part of: Advanced Engineering Fundamentals

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#### Competence Certificate

The assessment is carried out as a written exam (2 hours).

#### Competence Goal

The students...

- are capable to design and dimension components according to their load.
- can include mechanical material properties from the mechanical material test in the dimensioning process.
- can identify superimposed total loads and critical loads on simple components and to compute them.
- acquire the skill to select materials based on the application area of the components and respective loads.

#### Prerequisites

none

#### Content

The aim of the lecture is to present the topics of the dimensioning and the material science in their connection and to learn how to deal with corresponding methods and the combination thereof.

For the prospective engineer the most important educational objective is to understand the interaction of these topics while the interplay of the individual material stresses in the component are clarified.

#### The topics in detail are

- Structural dimensioning: basic stresses, superimposed stresses, notch influence, fatigue limit, fatigue strength, assessment of cracked components, operational strength, residual stresses, high temperature stress and corrosion
- Material selection: Basics, material indices, material selection diagrams, Ashby procedure, multiple boundary conditions, target conflicts, shape and efficiency.

#### Workload

The workload for the lecture “Product Development - Dimensioning of Components” is 210 h per semester and consists of the presence during the lectures (50 h) including tutorials, preparation and rework time at home (80 h) and preparation time for the oral exam (80 h).

#### Learning type

Lectures  
Tutorials
Module: Product Development - Methods of Product Development [M-MACH-102718]

Responsible: Prof. Dr.-Ing. Albert Albers
Organisation: KIT Department of Mechanical Engineering

Part of: Advanced Engineering Fundamentals

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Mandatory

T-MACH-109192 Methods and Processes of PGE - Product Generation Development 6 CR Albers, Burkardt, Matthiesen

Competence Certificate
Written examination (processing time: 120 min + 10 min reading time)

Competence Goal
The students are able to ...

• classify product development in companies and differentiate between different types of product development.
• name the relevant influencing factors of a market for product development.
• name, compare and use the central methods and process models of product development within moderate complex technical systems.
• explain problem solving techniques and associated development methods.
• explain product profiles and to differentiate and choose suitable creative techniques of solution/idea generation finding on this basis.
• use design guidelines to create simple technical systems and to explain these guidelines.
• name and compare quality assurance methods; to choose and use suitable methods for particular applications.
• explain the different methods of design of experiment.
• explain the costs in development process.

Prerequisites
None

Content
Basics of Product Development: Basic Terms, Classification of the Product Development into the industrial environment, generation of costs / responsibility for costs
Concept Development: List of demands / Abstraction of the Problem Definition / Creativity Techniques / Evaluation and selection of solutions
Drafting: Prevailing basic rules of Design / Design Principles as a problem oriented accessory
Quality Assurance in early Development Phases: Methods of Quality Assurance in an overview/QFD/FMEA

Workload
1. Time of presence lecture: 15 * 3h= 45 h
2. Prepare/follow-up lecture: 15 * 4,5 h = 67,5 h
3. Time of presence exercise: 4 * 1,5h = 6 h
4. Prepare/follow-up exercise: 4 * 3 h = 12 h
5. Exam preparation and time of presence: 49,5 h
Total: 180 h = 6 LP

Learning type
Lecture
Tutorial
Literature
Lecture documents
Pahl, Beitz: Konstruktionslehre, Springer-Verlag 1997
Hering, Triemel, Blank: Qualitätssicherung für Ingenieure; VDI-Verlag, 1993
# 10 Courses

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

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

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-102643 - Major Field: Fusion Technology

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<td>Each term</td>
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### Events

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<th>SWS</th>
<th>Type</th>
<th>Lecturer</th>
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<td>WT 21/22</td>
<td>2189404</td>
<td>A holistic approach to power plant management</td>
<td>2 SWS</td>
<td>Lecture / 🖥</td>
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### Exams

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<td>A holistic approach to power plant management</td>
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**Competence Certificate**

oral exam of about 30 minutes

**Prerequisites**

none

**Annotation**

none

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

### A holistic approach to power plant management

<table>
<thead>
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<th>Code</th>
<th>WS</th>
<th>Language</th>
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<tbody>
<tr>
<td>2189404</td>
<td>21/22</td>
<td>English</td>
<td><a href="#">Open in study portal</a></td>
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</tbody>
</table>
Content

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

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

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

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

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

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

Oral exam of about 25 min.

Literature

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

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

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102598 - Major Field: Advanced Mechatronics  
- M-MACH-102615 - Major Field: Medical Technology  
- M-MACH-102616 - Major Field: Microsystem Technology  
- M-MACH-102647 - Major Field: Microactuators and Microsensors

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**Events**

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<td>Lecture / 🧩</td>
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**Exams**

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<td>Actuators and Sensors in Nanotechnology</td>
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**Legend:**  
🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🗓 Cancelled

**Competence Certificate**
oral exam

**Prerequisites**
none

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

**Actuators and sensors in nanotechnology**
2141866, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**
Blended (On-Site/Online)
10.3 Course: Advanced CFD with OpenFOAM [T-MACH-111390]

**Responsible:** Dr. Nima Samkhaniani  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102634 - Major Field: Fluid Mechanic  
M-MACH-102634 - Major Field: Fluid Mechanic

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**Exams**

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<td>1 terms</td>
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Legend: 🌐 Online, 🧩 Blended (On-Site/Online), 🗂️ On-Site, ✗ Cancelled

**Competence Certificate**

oral exam, app. 30 min

**Prerequisites**

None

**Recommendation**

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

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

**Advanced CFD with OpenFOAM**

2153470, WS 21/22, 2 SWS, Language: English, Open in study portal

**Lecture (V)**

Blended (On-Site/Online)

**Content**

OpenFOAM ® software toolbox provides a collection of ready-to-go solvers and libraries for application in different fields of fluid mechanics. In spite of the great variety of available tools, research-oriented application of OpenFOAM ® is often linked to the necessity of significant modifications in boundary conditions and governing transport equations due to the novelty of the proposed models rarely available "out-of-the-box". In this course we approach the development and extension of numerical models in the framework of OpenFOAM ®. The course focuses on:

● modification/implementation of boundary conditions  
  (e.g. time-dependent boundary conditions),  
● extension of implemented transport equations  
  (e.g. extension of momentum equation with a source term for representation of a solid body in the fluid domain - porosity or immersed boundary method),  
● solver extension with additional transport equations  
  (e.g. solver extension with passive scalar equation for computation of temperature),  
● implementation of new models  
  (e.g. modification or implementation of a new turbulence model).  

The course is based on lectures, tutorials and assignments, which will have to be independently accomplished by the course participants.

Course content:

● basic OpenFOAM ® mathematics (tensorial operations, discretization),  
● advanced customization of boundary conditions and pre/post-processing with third-party tools (swak4Foam: groovyBC, funkySetField, funkyDoCalc),  
● introduction to C++,  
● advanced run-time OpenFOAM ® modification with codeStream,  
● customizing solvers or developing new solvers in OpenFOAM ®,  
● git for code development.
**Literature**
10.4 Course: Aerodynamics I [T-MACH-111032]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102634 - Major Field: Fluid Mechanic

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

**Events**

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**Responsible:** Kriegseis, Gatti

**Competence Certificate**

oral exam 30 minutes

**Recommendation**

The content of lecture "Mathematical Methods in Fluid Mechanics" (LVNr. 2154432)  
The content of lecture "Vortex Dynamics" (LVNr. 2153438)  
The content of lecture "Fluid Mechanics I" (LVNr. 3154510)  
The content of lecture "Fluid Mechanics II" (LVNr. 3153511)

**Annotation**

The lecture is jointly provided with the "Institute for Fluid Mechanics and Aerodynamics (SLA)" of TU Darmstadt. Prof. Jeanette Hussong and M.Sc. Johannes Kissing contribute as additional lecturers from SLA.

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

**Aerodynamics I**

2153480, WS 21/22, 3 SWS, Language: German, Open in study portal

**Content**

Incompressible aerodynamics:
review of governing equations, potential flow, boundary-layer theory, airfoil theory, lifting-line and wing theory, aerodynamics of fuselages, experimental aerodynamics, wind turbines

**Organizational issues**

Die Lehrveranstaltung wird gemeinsam mit dem Fachgebiet "Strömungslehre & Aerodynamik (SLA)" der TU Darmstadt angeboten. Prof. Jeanette Hussong und Dr. Johannes Kissing beteiligen sich als zusätzliche Dozenten von SLA.

Die Veranstaltung wird online angeboten, weitere Informationen finden Sie in Ilias.

The lecture is jointly provided with the "Institute for Fluid Mechanics and Aerodynamics (SLA)" of TU Darmstadt. Prof. Jeanette Hussong and Dr. Johannes Kissing contribute as additional lecturers from SLA.

The lecture is offered online, further information can be found in the ILIAS course.

**Literature**

Literatur:
### 10.5 Course: Aerothermodynamics [T-MACH-105437]

**Responsible:** Prof. Dr.-Ing. Bettina Frohnapfel  
Prof. Dr.-Ing. Friedrich Seiler  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102634 - Major Field: Fluid Mechanic  

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**Events**

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**Exams**

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

**Competence Certificate**

oral exam 30 minutes

**Prerequisites**

none

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

**V Aerothermodynamics**  
2154436, SS 2021, 2 SWS, Language: German, [Open in study portal](#)  

**Content**

- Nature of a hypersonic flow  
- Fundamentals of aerothermodynamics  
- Problems during re-entry  
- Flow regimes during re-entry  
- Applied hypersonic research

**Organizational issues**

Maximal 10 Personen

**Literature**

H. Oertel jun.: Aerothermodynamik, Springer-Verlag, Berlin Heidelberg New York, 1994  
F. Seiler: Skript zur Vorlesung über Aerothermodynamik
10 COURSES

Course: Airport Logistics [T-MACH-105175]

Responsible: Dr.-Ing. André Richter
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102625 - Major Field: Information Technology of Logistic Systems
M-MACH-102629 - Major Field: Logistics and Material Flow Theory
M-MACH-102640 - Major Field: Technical Logistics

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

Competence Certificate
The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

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

Content

Media
Presentations

Learning content

- Introduction
- Airport installations
- Luggage transport
- Passenger transport
- Security on the airport
- Legal bases of the air traffic
- Freight on the airport

Learning goals
The students are able to:

- Describe material handling and information technology activities on airports,
- Evaluate processes and systems on airports as the law stands, and
- Choose appropriate processes and material handling systems for airports.

Recommendations
None

Workload
Regular attendance: 21 hours
Self-study: 99 hours

Note
Limited number of participants: allocation of places in sequence of registration (first come first served). Registration via "ILIAS" mandatory.
Personal presence during lectures mandatory.

Organizational issues
Literature
10 COURSES

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

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

**Responsible:** Prof. Dipl.-Ing. Karl Ernst Noreikat

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102607 - Major Field: Vehicle Technology

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**Exams**

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

**Competence Certificate**

written exam

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

**Sustainable Vehicle Drivetrains**

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

**Content**

History
Infrastructure
Market Situation
Legislation
Alternative Fuels
Innovative Drivetrains
Hybrids
Plug-In Hybrids
BEV
Fuel Cells

**Organizational issues**

Die Vorlesung beginnt um 14 h und endet um 15:30 h (nicht um 17:30 h)
10.8 Course: Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines [T-MACH-105173]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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Exams

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<th>Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines</th>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Letter of attendance or oral exam (25 minutes, no auxiliary means)

Prerequisites
none

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

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

Responsible: Jürgen Pfeil
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102635 - Major Field: Engineering Thermodynamics
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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

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

Prerequisites
none

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

Analysis tools for combustion diagnostics
2134134, SS 2021, 2 SWS, Language: German, Open in study portal

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

Analysis tools for combustion diagnostics
2134134, SS 2021, 2 SWS, Language: German, Open in study portal

Literature
Skript, erhältlich in der Vorlesung
10.10 Course: Anatomy/Sports Medicine I [T-GEISTSOZ-103287]

**Responsible:** Prof. Dr. Stefan Sell

**Organisation:**

Part of: M-MACH-102615 - Major Field: Medical Technology

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
10.11 Course: Appliance and Power Tool Design [T-MACH-105229]

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

Part of: M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

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Events

| ST 2021 | 2145164 | Appliance and Power Tool Design | 3 SWS | Lecture / 🖥 | Matthiesen |
| ST 2021 | 2145165 | Appliance and Power Tool Design Project Work | 1 SWS | Project (P / 🖥) | Matthiesen, Mitarbeiter |

Exams

| ST 2021 | 76-T-MACH-105229 | Appliance and Power Tool Design | Matthiesen |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗠️ On-Site, ⚪️ Cancelled

Competence Certificate
Oral examination (20 min)

Prerequisites
The participation in “Appliance and power tool design” requires the concurrent project work. Due to organizational reasons, the number of participants is limited. At the beginning of August, a registration form will be available at the IPEK website. In the case of too many applicants, a selection process will be taking place. An early application is advantageous.

Modeled Conditions
The following conditions have to be fulfilled:

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

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

**Appliance and Power Tool Design**
2145164, SS 2021, 3 SWS, Language: German, Open in study portal

Organizational issues

Mündliche Prüfung
Prüfungsdauer: 30 min
Hilfsmittel: keine
Gemeinsame Prüfung von Vorlesung und Projektarbeit.

**Appliance and Power Tool Design Project Work**
2145165, SS 2021, 1 SWS, Open in study portal

Organizational issues
Weitere Informationen werden zum Vorlesungsbeginn über Ilias und die IPEK-Homepage bekannt gegeben.
### 10.12 Course: Appliance and Power Tool Design Project Work [T-MACH-110767]

**Responsible:** Prof. Dr.-Ing. Sven Matthiesen  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

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**Exams**

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

**Competence Certificate**

Presentation of performed project and defense (30min) according to $4 \ (2)$, No. 3 of the examination regulation

**Annotation**

The participation in the project work requires the participation in “Appliance and power tool design”. Due to organizational reasons, the number of participants is limited. At the beginning of august, a registration form will be available at the IPEK website. In the case of too many applicants, a selection process will be taking place. An early application is advantageous.

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

**Appliance and Power Tool Design Project Work**  
2145165, SS 2021, 1 SWS, Open in study portal

**Project (PRO)**  
Online

**Organizational issues**

Weitere Informationen werden zum Vorlesungsbeginn über Ilias und die IPEK-Homepage bekannt gegeben.
10.13 Course: Application of Advanced Programming Languages in Mechanical Engineering [T-MACH-105390]

Responsible: Dr. Daniel Weygand
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102604 - Major Field: Computational Mechanics

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Events

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<td>4 SWS</td>
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Exams

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<td>Weygand</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
It is not possible, to combine this brick with brick Scientific computing for Engineers [T-MACH-100532].

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-100532 - Scientific Computing for Engineers must not have been started.

Annotation
The lecture is no longer offered.
Remaining examinations must be taken by summer semester 2022 at the latest.

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

Application of advanced programming languages in mechanical engineering
2182735, SS 2021, 4 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ) Online
Content
This lecture gives an introduction to advances programming and scripting languages and numerical methods under UNIX/Linux:

* Fortran 95/2003
  - structure of source code
  - programing
  - compiling
  - debugging
  - parallelization with OpenMP
* numerical methods
* script languages: Python, awk
* visualisation

The lecture is supplemented by a computer exercise.

The student can

  * utilise the programming language Fortran 95 and Fortran 2003 to implement simple numerical simulations
  * apply a script languages awp resp. python for data treatment

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

Organizational issues

  * Kursbeitritt erfolgt bis zum 14.4.2021 (erste Vorlesung) ohne Passwort.
  * Die Veranstaltung wird asynchron angeboten.
  * Die Vorlesungsfolien und eine Audiobesprechung der wichtigsten Elemente der Vorlesung werden über ILIAS zugänglich gemacht.

Literature

2. Intel Fortran compiler handbook.
## 10.14 Course: Applied Chemistry [T-CHEMBIO-100302]

**Organisation:** KIT Department of Chemistry and Biosciences  
**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

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<td>ST 2021</td>
<td>7100050</td>
<td>Applied Chemistry, 2nd written exam</td>
<td>Deutschmann, Meier, Grunwaldt, Théato</td>
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</table>
10.15 Course: Applied Materials Simulation [T-MACH-105527]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

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**Events**

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<tr>
<td>2182614</td>
<td>Gumbsch, Schulz</td>
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**Exams**

<table>
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<th>Applied Materials Modelling</th>
</tr>
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<tbody>
<tr>
<td>76-T-MACH-105527</td>
<td>Gumbsch, Schulz</td>
</tr>
</tbody>
</table>

Legend: 📐 Online, 🧩 Blended (On-Site/Online), 🔊 On-Site, ✗ Cancelled

**Competence Certificate**

oral exam ca. 30 minutes  
no tools or reference materials

**Prerequisites**
The successful participation in Übungen zu Angewandte Werkstoffsimulation is the condition for the admittance to the oral exam in Angewandte Werkstoffsimulation.

T-MACH-110928 – Exercises for Applied Materials Simulation has not been started.  
T-MACH-110929 – Applied Materials Modelling has not been started.

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

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

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

**Applied Materials Simulation**

2182614, SS 2021, 4 SWS, Language: German, Open in study portal

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

The student can

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

preliminary knowledge in mathematics, physics and materials science recommended

regular attendance: 34 hours
exercise: 11 hours
self-study: 165 hours
oral exam ca. 35 minutes
no tools or reference materials
admission to the exam only with successful completion of the exercises

Organizational issues
Die Vorlesung wird nur als Aufzeichnung angeboten! 
Bitte besuchen Sie die englischsprachige Veranstaltung "Applied Materials Simulation" (21 82 616)!
Weitere Informationen finden Sie in ILIAS.
Kontakt: johannes.schneider@kit.edu

Literature

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

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

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

| ST 2021 | 2182616 | Applied Materials Simulation | 4 SWS | Lecture / Practice (VÜ) | Schulz, Gumbsch |

**Exams**

| ST 2021 | 76-T-MACH-110929 | Applied Materials Simulation | Gumbsch |

**Competence Certificate**

oral exam ca. 30 minutes  
no tools or reference materials

**Prerequisites**

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

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

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

**Modeled Conditions**

The following conditions have to be fulfilled:

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

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

**Applied Materials Simulation**

2182616, SS 2021, 4 SWS, Language: English, Open in study portal
Content
This lecture should give the students an overview of different simulation methods in the field of materials science and engineering. Numerical methods are presented and their use in different fields of application and size scales shown and discussed. On the basis of theoretical as well as practical aspects, a critical examination of the opportunities and challenges of numerical material simulation shall be carried out.

The student can

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

preliminary knowledge in mathematics, physics and materials science recommended
regular attendance: 34 hours
exercise: 11 hours
self-study: 165 hours
oral exam ca. 35 minutes
no tools or reference materials
admission to the exam only with successful completion of the exercises

Organizational issues
The lecture is made available weekly as a link.
Further information can be found in ILIAS.
Contact: johannes.schneider@kit.edu

Literature
10.17 Course: Applied Mathematics in Natural Science: Flows with chemical reactions [T-MACH-108847]

**Responsible:** apl. Prof. Dr. Andreas Class  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

**Type**  
Completed coursework (oral)  
Credits: 6  
Grading scale: pass/fail  
Recurrence: Each winter term  
Version: 1

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<td>WT 21/22</td>
<td>2153406</td>
<td>Flows with chemical reactions</td>
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<td>ST 2021</td>
<td>76-T-MACH-105422</td>
<td>Flows with Chemical Reactions</td>
</tr>
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</table>

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

**Competence Certificate**
The study performance is considered to have been passed if all exercise assignments have been successfully processed and the final colloquium (30 minutes) has been successfully passed.

**Prerequisites**
none

**Recommendation**
Fluid Mechanics (T-MACH-105207)  
Mathematical Methods in Fluid Mechanics (T-MACH-105295)

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

**Flows with chemical reactions**
2153406, WS 21/22, 2 SWS, Language: German/English, Open in study portal  
Lecture (V)  
Online

**Content**
The students can describe flow scenarios, where a chemical reaction is confined to a thin layer. They can choose simplifying approaches for the underlying chemistry and discuss the problems with focus on the fluid mechanic aspects. The students are able to solve simple problems analytically. Furthermore, they are qualified to discuss simplifications as relevant for an efficient numerical solution of complex problems.

In the lecture we mainly consider problems, where chemical reaction is confined to a thin layer. The problems are solved analytically or they are at least simplified allowing for efficient numerical solution procedures. We apply simplified chemistry and focus on the fluid mechanic aspects of the problems.

**Literature**
Vorlesungsskript

Buckmaster, J.D.; Ludford, G.S.S.: Lectures on Mathematical Combustion, SIAM 1983
10 COURSES  

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

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

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

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

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102599 - Major Field: Powertrain Systems
- M-MACH-102605 - Major Field: Engineering Design
- M-MACH-102637 - Major Field: Tribology

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

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<td>2 SWS</td>
<td>Lecture / 🖥</td>
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**Exams**

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</table>

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🔊 On-Site, ⚩ Cancelled

**Competence Certificate**
- oral exam (20 min)

**Prerequisites**
- None

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

**Applied Tribology in Industrial Product Development**

2145181, WS 21/22, 2 SWS, Language: German, Open in study portal

**Lecture (V) Online**

**Content**

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

The students are able to

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

Further content:

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

**Regular attendance:** 21 h

**Self-study:** 99 h

**Exam:** oral exam
Literature
Vorlesungsfolien werden im Ilias veröffentlicht.
The lecture script will be allocated at Ilias.
10.19 Course: Atomistic Simulations and Molecular Dynamics [T-MACH-105308]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering  
M-MACH-102604 - Major Field: Computational Mechanics  
M-MACH-102611 - Major Field: Materials Science and Engineering  
M-MACH-102637 - Major Field: Tribology  
M-MACH-102649 - Major Field: Advanced Materials Modelling  
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics

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<th>Recurrence</th>
<th>Version</th>
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<td>Grade to a third</td>
<td>Each summer term</td>
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**Events**

| ST 2021  | 2181740 | Atomistic simulations and molecular dynamics | 3 SWS | Lecture / Practice ( hảo  ) | Weygand, Gumbsch |

**Exams**

| ST 2021  | 76T-MACH-105308 | Atomistic Simulations and Molecular Dynamics | Weygand, Gumbsch |
| ST 2021  | 76-T-MACH-105308-W | Atomistic Simulations and Molecular Dynamics | Weygand, Gumbsch |

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

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

**Prerequisites**
none

**Recommendation**
preliminary knowledge in mathematics, physics and materials science

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

<table>
<thead>
<tr>
<th>V</th>
<th>Atomistic simulations and molecular dynamics</th>
<th>Lecture / Practice (VÜ)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2181740, SS 2021, 3 SWS, Language: English, Open in study portal</td>
<td>Online</td>
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</tbody>
</table>

Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021  
Module Handbook, valid from Winter Term 2021/2022
Content
The lecture introduces the foundation of particle based simulation methods focusing on molecular dynamics:

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

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

The student can

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

preliminary knowledge in mathematics, physics and materials science recommended

regular attendance: 22.5 hours
exercise: 22.5 hours
self-study: 75 hours
oral exam ca. 30 minutes

Organizational issues
Die Vorlesung wird auf Englisch angeboten!


Kontakt: daniel weygand@kit.edu

Admission to the course is possible until 15.4.2021 (first lecture) without password. The course is offered asynchronously. The lecture slides and an audio review of the most important elements of the lecture will be made accessible via ILIAS.

Literature

10.20 Course: Automated Manufacturing Systems [T-MACH-108844]

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

Part of:
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102601 - Major Field: Automation Technology
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-102618 - Major Field: Production Technology
- M-MACH-102628 - Major Field: Lightweight Construction
- M-MACH-102633 - Major Field: Robotics
- M-MACH-102640 - Major Field: Technical Logistics
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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<th>Grading scale</th>
<th>Recurrence</th>
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<td>Grade to a third</td>
<td>Each summer term</td>
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Events

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<td>2150904</td>
<td>Automated Manufacturing Systems</td>
<td>6 SWS</td>
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<td>Automated Manufacturing Systems</td>
<td>Fleischer</td>
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</tbody>
</table>

Competence Certificate
oral exam (40 minutes)

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

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

Automated Manufacturing Systems
2150904, SS 2021, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
Online
Content
The lecture provides an overview of the structure and functioning of automated manufacturing systems. In the introduction chapter the basic elements for the realization of automated manufacturing systems are given. This includes:

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

An interdisciplinary view of these subareas enables Industry 4.0 solutions.

In the second part of the lecture, the basics are illustrated using implemented manufacturing processes for the production of automotive components (chassis and drive technology). The analysis of automated manufacturing systems for manufacturing of defined components is also included.

In the field of vehicle power train both, the automated manufacturing process for the production of the conventional internal-combustion engine and the automated manufacturing process for the production of the prospective electric power train (electric motor and battery) are considered. In the field of car body, the focus is on the analysis of the process chain for the automated manufacturing of conventional sheet metal body parts, as well as for automated manufacturing of body components made out of fiber-reinforced plastics.

Within tutorials, the contents from the lecture are advanced and applied to specific problems and tasks.

Learning Outcomes:
The students …

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

Workload:
MACH:
regular attendance: 63 hours
self-study: 177 hours

WING:
regular attendance: 63 hours
self-study: 207 hours

Organizational issues
Vorlesungstermine dienstags 8.00 Uhr und donnerstags 8.00 Uhr, Übungstermine donnerstags 9.45 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/).
10.21 Course: Automated Visual Inspection and Image Processing [T-INFO-101363]

**Responsible:** Prof. Dr.-Ing. Jürgen Beyerer

**Organisation:** KIT Department of Informatics

**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

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

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<td>4 SWS</td>
<td>Lecture</td>
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**Exams**

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

Automated Visual Inspection and Image Processing

**24169, WS 21/22, 4 SWS, Language: German, Open in study portal**

**Lecture (V)**

**Content**

**Topics covered:**

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

**Educational objective:**

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

**Organizational issues**

Die Erfolgskontrolle wird in der Modulbeschreibung erläutert.

**Empfehlungen:**

Grundkenntnisse der Optik und der Signalverarbeitung sind hilfreich.

**Literature**

Weiterführende Literatur

### 10.22 Course: Automotive Engineering I [T-MACH-100092]

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

**Organisation:**  
KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102605 - Major Field: Engineering Design  
M-MACH-102607 - Major Field: Vehicle Technology  
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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<td>Each winter term</td>
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<td>Automotive Engineering I</td>
<td>Lecture /  🖥</td>
<td>Gauterin, Gießler</td>
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**Exams**

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**Competence Certificate**

Written examination

Duration: 120 minutes

Auxiliary means: none

**Prerequisites**

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

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

### Automotive Engineering I

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

**Content**

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

**Learning Objectives:**

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

**Organizational issues**

Kann nicht mit der Veranstaltung [2113809] kombiniert werden.

Can not be combined with lecture [2113809].

---

Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021  
Module Handbook, valid from Winter Term 2021/2022
Literature

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

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

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

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

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

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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

| ST 2021 | 2114835 | Automotive Engineering II | 2 SWS | Lecture / Online | Unrau |
| ST 2021 | 2114855 | Automotive Engineering II | 2 SWS | Lecture / Online | Gießler |

**Exams**

| ST 2021 | 76-T-MACH-102117 | Automotive Engineering II | Unrau, Gauterin |
| ST 2021 | 76T-MACH-102117_2 | Automotive Engineering II | Gauterin |
| WT 21/22 | 76-T-MACH-102117 | Automotive Engineering II | Unrau, Gauterin |
| WT 21/22 | 76T-MACH-102117-2 | Automotive Engineering II | Gauterin, Unrau |

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

**Competence Certificate**

Written Examination

Duration: 90 minutes

Auxiliary means: none

**Prerequisites**

none

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

**Automotive Engineering II**

2114835, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**

1. Chassis: Wheel suspensions (rear axles, front axles, kinematics of axles), tyres, springs, damping devices
2. Steering elements: Manual steering, servo steering, steer by wire
3. Brakes: Disc brake, drum brake, comparison of 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]
Autotive Engineering II
2114855, SS 2021, 2 SWS, Language: English, Open in study portal

Content

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

Learning Objectives:

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

Literature

Elective literature:

10.24 Course: Automotive Vision [T-MACH-105218]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-102609 - Major Field: Cognitive Technical Systems
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102624 - Major Field: Information Technology
- M-MACH-102625 - Major Field: Information Technology of Logistic Systems
- M-MACH-102630 - Major Field: Mobile Machines
- M-MACH-102633 - Major Field: Robotics
- M-MACH-102641 - Major Field: Rail System Technology

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<td>Each summer term</td>
<td>2</td>
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**Events**

| ST 2021 | 2138340 | Automotive Vision | 3 SWS | Lecture / Online | Lauer, Peter |

**Exams**

| ST 2021 | 76-T-MACH-105218 | Automotive Vision | Lecture / Online | Stiller, Lauer |

**Competence Certificate**

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

**Prerequisites**

none

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

### Content

**Lernziele (EN):**

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

**Lehrinhalt (EN):**

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

Nachweis: Written examination 60 minutes

**Arbeitsaufwand (EN):** 120 hours
Literatur
Foliensatz zur Veranstaltung wird als kostenlose pdf-Datei bereitgestellt. Weitere Empfehlungen werden in der Vorlesung bekannt gegeben.
10 COURSES

Course: Basics of Technical Logistics I [T-MACH-109919]

Responsible: Dr.-Ing. Martin Mittwollen
Jan Oellerich

Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102618 - Major Field: Production Technology
- M-MACH-102640 - Major Field: Technical Logistics
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
- M-MACH-102742 - Fundamentals and Methods of Production Technology
- M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

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

Events

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### Events

| WT 21/22 | 2117095 | Basics of Technical Logistics | 3 SWS | Lecture / Practice (VÜ) | Mittwollen, Oellerich |

### Exams

| ST 2021  | 76-T-MACH-109919 | Basics of Technical Logistics I | Mittwollen |
| ST 2021  | 76-T-MACH-109919-mPr | Basics of Technical Logistics I | Mittwollen |
| WT 21/22 | 76-T-MACH-109001 | Basics of Technical Logistics I | Mittwollen |
| WT 21/22 | 76-T-MACH-109919 | Basics of Technical Logistics I | Mittwollen |

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

### Competence Certificate

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

### Prerequisites

none

### Recommendation

Knowledge of the basics of technical mechanics preconditioned.

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

#### Basics of Technical Logistics

2117095, WS 21/22, 3 SWS, Language: German, [Open in study portal](#)
Content

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

Students are able to:

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

Organizational issues

Die Erfolgskontrolle erfolgt in Form einer schriftlichen oder mündlichen Prüfung (nach §4 (2), 1 bzw. 2 SPO).

The assessment consists of a written or oral exam according to Section 4 (2), 1 or 2 of the examination regulation.

Es wird Kenntnis der Grundlagen der Technischen Mechanik vorausgesetzt.

Basics knowledge of technical mechanics is preconditioned.

Ergänzungsblätter, Präsentationen, Tafel.

Supplementary sheets, presentations, blackboard.

Präsenz: 48 Std
Nacharbeit: 132 Std

Presence: 48h
Rework: 132h

Literature

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

**Responsible:** Dr.-Ing. Maximilian Hochstein  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102618 - Major Field: Production Technology  
- M-MACH-102640 - Major Field: Technical Logistics  
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering  
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction  
- M-MACH-102742 - Fundamentals and Methods of Production Technology

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**Events**

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<td>Basics of Technical Logistics II</td>
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<td>Basics of Technical Logistics II</td>
<td>Mittwollen</td>
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</table>

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

**Prerequisites**

none

**Recommendation**

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

Responsible: Maximilian Naumann
Dr. Moritz Werling

Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102601 - Major Field: Automation Technology
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-102609 - Major Field: Cognitive Technical Systems
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102624 - Major Field: Information Technology
- M-MACH-102630 - Major Field: Mobile Machines
- M-MACH-102633 - Major Field: Robotics
- M-MACH-102640 - Major Field: Technical Logistics

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

Events

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<td>WT 21/22</td>
<td>2138336</td>
<td>Behaviour Generation for Vehicles</td>
<td>2 SWS</td>
<td>Lecture / Online</td>
<td>Werling, Stiller</td>
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Exams

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<td>Behaviour Generation for Vehicles</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

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

Prerequisites
none

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

Behaviour Generation for Vehicles
2138336, WS 21/22, 2 SWS, Language: German, Open in study portal

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

Nachweis: written exam
Arbeitsaufwand: 120 hours
Organizational issues

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

Responsible: Dr.-Ing. Axel Loewe
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering
M-MACH-102615 - Major Field: Medical Technology

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Exams

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

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

Prerequisites
none
10.29 Course: Biologically Inspired Robots [T-INFO-101351]

**Responsible:** Prof. Dr.-Ing. Rüdiger Dillmann  
Dr.-Ing. Arne Rönnau  

**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-102633 - Major Field: Robotics

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**Events**

| ST 2021 | 24619 | Biologisch Motivierte Robotersysteme | 2 SWS | Lecture / 🖥 | Rönnau |

**Exams**

| ST 2021 | 7500237 | Biologically Inspired Robot | Rönnau |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
10.30 Course: Biology for Engineers I [T-CIWVT-103113]

**Responsible:** Prof. Dr. Christoph Syldatk

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

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**Exams**

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

**Competence Certificate**

This module is successfully completed by a written exam of 180 min (according to § 4 Abs. 2 SPO).

**Prerequisites**

None
10.31 Course: Biomechanics: Design in Nature and Inspired by Nature [T-MACH-105651]

**Responsible:** Prof. Dr. Claus Mattheck  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102611 - Major Field: Materials Science and Engineering

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

| WT 21/22 | 2181708 | Biomechanics: Design in Nature and Inspired by Nature | 3 SWS | / | Mattheck |

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

**Competence Certificate**  
Colloquium, ungraded.

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

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

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

**Biomechanics: Design in Nature and Inspired by Nature**  
2181708, WS 21/22, 3 SWS, Language: German, [Open in study portal](#)  
On-Site

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

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

**regular attendance:** 30 hours  
**self-study:** 90 hours
10.32 Course: Biomedical Measurement Techniques I [T-ETIT-106492]

Responsible: Prof. Dr. Werner Nahm

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of:
- M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering
- M-MACH-102615 - Major Field: Medical Technology

Type: Written examination
Credits: 3
Grading scale: Grade to a third
Recurrence: Each winter term
Version: 1

Events

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

Prerequisites
T-ETIT-101928 - Biomedizinische Messtechnik I darf weder begonnen noch abgeschlossen sein.
### 10.33 Course: Biomedical Measurement Techniques II [T-ETIT-101929]

<table>
<thead>
<tr>
<th>Responsible</th>
<th>Prof. Dr. Olaf Dössel</th>
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<tr>
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<td>Recurrence</td>
<td>Each summer term</td>
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<td>Version</td>
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**Prerequisites**
none
10.34 Course: Biomedical Measurement Techniques II [T-ETIT-106973]

Responsible: Prof. Dr. Werner Nahm
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102615 - Major Field: Medical Technology

<table>
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Exams

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Legend: 📲 Online, 🔄 Blended (On-Site/Online), 📜 On-Site, ☑ Cancelled

Competence Certificate
Success is checked in the form of a written test of 60 minutes. The module grade is the grade of the written exam. Bonus points can also be awarded. You can find information on this under "Module grade".

Prerequisites
The successful participation in the module Biomedical Measurement Techniques I is a prerequisite.

Recommendation
Basics in physiology. Basics in physical measurement technology, good previous knowledge of analog circuit technology and in digital signal processing.

Annotation
The event is based on an interactive combination of lecture parts and seminar parts. In the seminar part, the participants are asked to independently prepare and present individual topics of the course in small groups. These contributions are evaluated and the students receive bonus points for this. The bonus points are added to the points achieved in the written exam. The sum of the points gives the module grade.
10.35 Course: BioMEMS - Microfluidic Chipsystems V [T-MACH-111069]

Responsible:  apl. Prof. Dr. Andreas Guber  
              Dr. Taleieh Rajabi

Organisation:  KIT Department of Mechanical Engineering

Part of:  M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

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<td>Guber, Ahrens</td>
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Competence Certificate
oral exam (appr. 20 Min.)

Prerequisites
none
**Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I [T-MACH-100966]**

**Responsible:** apl. Prof. Dr. Andreas Guber

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102615 - Major Field: Medical Technology
- M-MACH-102616 - Major Field: Microsystem Technology
- M-MACH-102647 - Major Field: Microactuators and Microsensors

**Type**
- Written examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each winter term

**Version**
- 2

**Events**

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

**Prerequisites**
none

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

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

<table>
<thead>
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**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
10 COURSES
Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II [T-MACH-100967]

10.37 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II [T-MACH-100967]

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

Part of:  M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102616 - Major Field: Microsystem Technology

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Events

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Legend: 📝 Online, 🧩 Blended (On-Site/Online), 🗿 On-Site, ✗ Cancelled

Competence Certificate
Written exam (75 Min.)

Prerequisites
none

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

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

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

Die Vorlesung wird voraussichtlich mit der Software ZOOM oder MS Teams zu den im Vorlesungsverzeichnis angekündigten Terminen (hier: Montag 11:30 - 13:00 Uhr) durchgeführt werden. Weitere Informationen werden sobald wie möglich via ILIAS zur Verfügung gestellt.
Literature
Menz, W., Mohr, J., O. Paul: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 2005

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

M. Madou
Fundamentals of Microfabrication
10 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III [T-MACH-100968]

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

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102615 - Major Field: Medical Technology
- M-MACH-102616 - Major Field: Microsystem Technology

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Events

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Exams

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

Competence Certificate
Written exam (75 Min.)

Prerequisites
none

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

BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III
2142879, SS 2021, 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
Die Vorlesung findet im Sommersemester aufgrund der aktuellen Situation bis auf Weiteres online statt. Zu jedem Vorlesungstermin werden via ILIAS die jeweiligen Folien im PDF-Format zur Verfügung gestellt.
Die Vorlesung wird voraussichtlich mit der Software ZOOM oder MS Teams zu den im Vorlesungsverzeichnis angekündigten Terminen (hier: Montag: 14:00 - 15:30 Uhr) durchgeführt werden. Weitere Informationen werden sobald wie möglich via ILIAS zur Verfügung gestellt.

Literature
Menz, W., Mohr, J., O. Paul: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 2005
Buess, G.: Operationslehre in der endoskopischen Chirurgie, Band I und II; Springer-Verlag, 1994
M. Madou
Fundamentals of Microfabrication
### 10 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine IV [T-MACH-106877]

**Responsible:** apl. Prof. Dr. Andreas Guber  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

<table>
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#### Events

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#### Exams

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#### Competence Certificate

Oral examination (45 Min.)

#### Prerequisites

none
10.40 Course: Bionic Inspired Reinforced Composites [T-MACH-106723]

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

**Part of:** M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

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**Competence Certificate**  
oral exam
10.41 Course: Bionics for Engineers and Natural Scientists [T-MACH-102172]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102615 - Major Field: Medical Technology
- M-MACH-102616 - Major Field: Microsystem Technology

**Type:** Oral examination

**Credits:** 4

**Grading scale:** Grade to a third

**Recurrence:** Each summer term

**Version:** 1

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### Events

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

### Exams

- **ST 2021:** 76-T-MACH-102172, Bionics for Engineers and Natural Scientists, Hölscher
- **WT 21/22:** 76-T-MACH-102172, Bionics for Engineers and Natural Scientists, Hölscher

---

### Competence Certificate

- written or oral exam

---

### Prerequisites

- none

---

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

### Bionics for Engineers and Natural Scientists

- **2142140, SS 2021, 2 SWS, Language: German, Open in study portal**

**Lecture (V) Online**

---

### Content

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

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

Basic knowledge in physics and chemistry

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

---

### Organizational issues


Die Prüfung findet als Klausur statt und es werden zwei Termine angeboten werden (voraussichtlich in der ersten Woche nach Vorlesungsende im Sommersemester und in der ersten Woche vor Vorlesungsbeginn im Wintersemester).

---

### Literature

Folien und Literatur werden in ILIAS zur Verfügung gestellt.
10.42 Course: Boosting of Combustion Engines [T-MACH-105649]

**Responsible:** Dr.-Ing. Johannes Kech  
Dr.-Ing. Heiko Kubach  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

<table>
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**Events**

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

**Competence Certificate**

oral exam, 20 min

**Prerequisites**

none
10.43 Course: BUS-Controls [T-MACH-102150]

**Responsible:** Simon Becker  
Prof. Dr.-Ing. Marcus Geimer  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102599 - Major Field: Powertrain Systems  
M-MACH-102614 - Major Field: Mechatronics  
M-MACH-102624 - Major Field: Information Technology  
M-MACH-102630 - Major Field: Mobile Machines

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

**Events**

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</table>

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

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

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

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

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

The number of participants is limited. A registration 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.

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

After the practical oriented lessons the students will be able to visualize the communication structure of different applications, design basic systems and evaluate the complexity of programming of the complete system. Hereunto the students program in the practical orientated lessons IFM-controllers using the programming environment CoDeSys.

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

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

<table>
<thead>
<tr>
<th>BUS-Controls</th>
<th>Lecture (V)</th>
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<tr>
<td>2114092, SS 2021, 2 SWS, Language: German, Open in study portal</td>
<td>Blended (On-Site/Online)</td>
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**Content**

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

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

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

**Literature**

*Weiterführende Literatur:*

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

**Responsible:** Kevin Daiß

Prof. Dr.-Ing. Marcus Geimer

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102624 - Major Field: Information Technology
- M-MACH-102630 - Major Field: Mobile Machines

<table>
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**Exams**

| ST 2021    | 76-T-MACH-108889 | BUS-Controls - Advance | Geimer |
| WT 21/22   | 76-T-MACH-108889 | BUS-Controls - Advance | Geimer |

**Competence Certificate**

Creation of control program

**Prerequisites**

none
10.45 Course: Business Administration for Engineers and IT professionals [T-MACH-109933]

Responsible: Heinz-Peter Sebregondi
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102613 - Major Field: Lifecycle Engineering

<table>
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Events

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<td>WT 21/22</td>
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<td>Seminar / 🛤</td>
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Exams

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<td>Seminar / 🗣</td>
<td>Sebregondi</td>
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Legend: 🖥 Online, 🛤 Blended (On-Site/Online), 🗣 On-Site, x Cancelled

Competence Certificate

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

Prerequisites

None

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

Business Administration for Engineers and IT professionals

2122303, SS 2021, 2 SWS, Language: German/English, Open in study portal

Seminar (S)

Online

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)

Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021
Module Handbook, valid from Winter Term 2021/2022
Business Administration for Engineers and IT professionals
2122303, WS 21/22, 2 SWS, Language: German/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.
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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 auf 12 Personen begrenzt. / Number of participants limited to 12 people.

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)
Course: Business Planning [T-WIWI-102865]

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

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

**Part of:** M-MACH-104323 - Major Field: Innovation and Entrepreneurship

---

### Type | Credits | Grading scale | Recurrence | Version
---|---|---|---|---
Examination of another type | 3 | Grade to a third | Each term | 1

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#### Events

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<th>Type</th>
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<td>ST 2021</td>
<td>2545007</td>
<td>Business Planning for Founders</td>
<td>2</td>
<td>Seminar / Online</td>
<td>Kleinn, Ntagiakou, Terzidis</td>
</tr>
<tr>
<td>ST 2021</td>
<td>2545109</td>
<td>Business Planning for Founders in the field of IT-Security (KASTEL)</td>
<td>2</td>
<td>Seminar / Online</td>
<td>Ntagiakou, Terzidis</td>
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<tr>
<td>WT 21/22</td>
<td>2545007</td>
<td>Business Planning for Founders</td>
<td>2</td>
<td>Seminar / Online</td>
<td>Wohlfeil, Bauman</td>
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#### Exams

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<tr>
<td>ST 2021</td>
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<td>2</td>
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<td>2</td>
<td>Terzidis</td>
</tr>
</tbody>
</table>

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

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**Competence Certificate**

Alternative exam assessment.

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**Prerequisites**

None

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**Recommendation**

None

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

**Business Planning for Founders**

2545007, SS 2021, 2 SWS, Language: English, [Open in study portal](#)

**Content**

The seminar introduces students to the basic concepts of business planning for entrepreneurs. On the one hand, this involves concepts for the concretisation of business ideas (business modelling, market potential assessment, resource planning, etc.) and on the other hand, the preparation of an implementable business plan (with or without VC financing). In the course of the seminar, the students are familiarized with methods of further developing patents and business ideas into a more concrete business plan and formulating them in a business plan.

**Organizational issues**

Block am 26.04., 03.05., 10.05. jeweils 9-17 Uhr

---

**Business Planning for Founders in the field of IT-Security (KASTEL)**

2545109, SS 2021, 2 SWS, Language: German/English, [Open in study portal](#)
Content
In order to identify opportunities, the participants should identify fields for entrepreneurial opportunities in a systematic web research. For this purpose, Systematic Mapping procedures will be adapted to the research of general web sources and applied to the research of interesting fields in the area of cyber security.

Information about the seminar:
In the seminar you will work in groups of max. 4 persons. Group applications are welcome but not a prerequisite for participation.

Some of the seminars will be held in English.
The focus of the seminar is Opportunity Recognition in the field of IT-Security, followed by ideation sessions with the aim to find possible applications for technologies that are developed at the KIT. Prototyping and also Pitching are part of the seminar.

Target group:
Master Students

Information on the allocation of seminar places:
The registration for the seminar is possible in the Wiwi portal in the period from 11.09.2019 to 05.10.2019 at 23:55 clock. To apply for the seminar, please send us a letter of motivation (max. 5 sentences).

Seminar contents:

- To identify opportunities, the participants should identify fields for entrepreneurial opportunities in a systematic web research. For this purpose, Systematic Mapping procedures will be adapted to the research of general web sources and applied to the research of interesting fields in the area of cyber security.
- All information will be discussed with experts on the second seminar day. The aim of the first two sessions is to develop a systematic segmentation of market needs.
- After the teams have been formed, the workshop "Technology Application Selection (TAS)" follows. This is a framework developed by EnTechnon that will help the teams to develop concrete business ideas based on given technologies. The three steps of the TAS will be the content of the third and fourth seminar days. Participants will generate ideas and then - based on specific criteria that we will provide - choose an idea on which they will build their value proposition.
- The final session before the final day will deal with prototyping and validation. This will use rapid prototyping and validation methods from the design thinking environment.
- On the last day - before their final presentations - the participants learn how to present the idea in a short presentation (pitch) to an interested audience.

Organizational issues
Blockveranstaltung im Rahmen des KASTEL Projekts am 12.05., 09.06., 23.06.

Business Planning for Founders
2545007, WS 21/22, 2 SWS, Language: English, Open in study portal

Content
The seminar introduces students to basic concepts of business planning based on technological innovations. On the one hand, this involves concepts for the concretization of business ideas (business modeling, market potential assessment, resource planning, etc.) and, on the other hand, the creation of a feasible business plan (with or without VC financing).

During the seminar, students are familiarized with methods to develop technological inventions and initial business ideas into a more concrete business plan. After completing this seminar, students will have learned and actually practiced the whole business model development process.
10.47 Course: CAD-NX Training Course [T-MACH-102187]

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102613 - Major Field: Lifecycle Engineering

<table>
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<th>Recurrence</th>
<th>Version</th>
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<td>2 SWS</td>
<td>Practical course / Ovtcharova, Mitarbeiter</td>
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<tr>
<td>WT 21/22</td>
<td>CAD-NX training course</td>
<td>2 SWS</td>
<td>Practical course / Ovtcharova, Mitarbeiter</td>
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<th>Version</th>
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<tbody>
<tr>
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<td>CAD-NX Training Course</td>
<td>2 SWS</td>
<td>Practical course / Ovtcharova</td>
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</tbody>
</table>

**Competence Certificate**
Practical verification as academic achievement by working on a design task on the CAD computer, duration: 60 min.

**Prerequisites**
None

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

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

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

**CAD-NX training course**
2123357, SS 2021, 2 SWS, Language: German/English, Open in study portal

**Practical course (P)**
Blended (On-Site/Online)

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

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

**Organizational issues**
Das Praktikum wird mehrmals in der vorlesungsfreien Zeit als einwöchige Blockveranstaltung angeboten. Weitere Informationen siehe ILIAS.

**Literature**
Praktikumsskript
Content

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

Students are able to:

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

Organizational issues
Siehe ILIAS zur Lehrveranstaltung

Literature
Praktikumsskript
**10.48 Course: CAE-Workshop [T-MACH-105212]**

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering  
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102598 - Major Field: Advanced Mechatronics  
M-MACH-102601 - Major Field: Automation Technology  
M-MACH-102605 - Major Field: Engineering Design  
M-MACH-102613 - Major Field: Lifecycle Engineering  
M-MACH-102614 - Major Field: Mechatronics  
M-MACH-102628 - Major Field: Lightweight Construction  
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools  
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering  
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology  
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction  
M-MACH-102742 - Fundamentals and Methods of Production Technology  
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

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**Events**

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<td>Block / 📞</td>
<td>Albers, Mitarbeiter</td>
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<tr>
<td>WT 21/22</td>
<td>3 SWS</td>
<td>Block / 📞</td>
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**Exams**

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<td>📞</td>
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**Competence Certificate**

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

**Prerequisites**

None

**Annotation**

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

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

**CAE-Workshop**

2147175, SS 2021, 3 SWS, Language: German, Open in study portal
Content

Content:

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

The students are able to:

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

Exam: 1h Regularly written

Regular attendance: 31.5 h
Self-study: 88.5 h

Organizational issues

Wir empfehlen den Workshop ab dem 5. Semester.
Anmeldung erforderlich. Weitere Informationen siehe IPEK-Homepage.
Anwesenheitspflicht

Literature

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

---

Content

Content:

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

The students are able to:

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- evaluate and to question the results of a simulation.
- identify and improve the mistakes of a simulation or optimization.

Exam: 1h Regularly written

Regular attendance: 31.5 h
Self-study: 88.5 h

Organizational issues

Wir empfehlen den Workshop ab dem 5. Semester.
Anmeldung erforderlich. Weitere Informationen siehe IPEK-Homepage.
Anwesenheitspflicht

Literature

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

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

Part of: M-MACH-102613 - Major Field: Lifecycle Engineering

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Events

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Exams

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<td>CATIA Advanced</td>
<td>Ovtcharova</td>
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</table>

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

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

Prerequisites
none

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

**CATIA advanced**
2123380, SS 2021, 3 SWS, Language: German/English, Open in study portal
Project (PRO) Blended (On-Site/Online)

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

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

Organizational issues
Siehe ILIAS-Kurs.

Literature
Keine / None

**Advanced CATIA**
2123380, WS 21/22, 3 SWS, Language: German/English, Open in study portal
Project (PRO) Blended (On-Site/Online)

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

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

Organizational issues
Siehe ILIAS zur Lehrveranstaltung

Literature
Keine / None
10.50 Course: Ceramic Matrix Composites [T-MACH-106722]

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

**Part of:** M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

<table>
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<td>Each winter term</td>
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**Competence Certificate:** oral exam
10 COURSES

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

10.51 Course: Ceramic Processing Technology [T-MACH-102182]

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

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

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Events

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<td>Ceramics Processing</td>
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Exams

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<td>Binder</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🔗 On-Site, ✗ Cancelled

Competence Certificate

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

Auxiliary means: none

The re-examination is offered upon agreement.

Prerequisites

none

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

Ceramics Processing

2126730, SS 2021, 2 SWS, Language: German, Open in study portal

Literature

10.52 Course: CFD for Power Engineering [T-MACH-105407]

**Responsible:** Dr. Ivan Otic

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102608 - Major Field: Nuclear Energy
- M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
- M-MACH-102643 - Major Field: Fusion Technology

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**Events**

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<th>CFD for Power Engineering</th>
<th>2 SWS</th>
<th>Lecture / Online</th>
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**Exams**

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</table>

**Competence Certificate**

Oral exam, 30 min

**Prerequisites**

none

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

**CFD for Power Engineering**

2130910, SS 2021, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V) Online**
Content

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

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

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

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

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

Literature
Vorlesungsskript
Projektskript und Unterlagen
10.53 Course: CFD-Lab Using OpenFOAM [T-MACH-105313]

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

Part of:
- M-MACH-102610 - Major Field: Power Plant Technology
- M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology
- M-MACH-102636 - Major Field: Thermal Turbomachines

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Exams

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<td>Practical course / 🧩</td>
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<td>Koch</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate
Successful solution of problems

Prerequisites
none

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

CFD-Lab using OpenFOAM
2169459, SS 2021, 3 SWS, Language: German, Open in study portal

Practical course (P)
Blended (On-Site/Online)

Content

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

The students are able to:

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

Organizational issues
Voraussichtlicher Termin des Praktikums: 26.07.-30.07.2021
Der aktuelle Status (Termin/Ort) wird auf der ITS-homepage bekanntgegeben.
Content

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

The students are able to:

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

Organizational issues
Praktikum findet in Präsent statt, sofern es die COVID-Inzidenzwerte zulassen.

Literature

• Dokumentation zu Open Foam
• www.open foam.com/docs
**Course: CO2-Neutral Combustion Engines and their Fuels I [T-MACH-111550]**

**Responsible:** Prof. Dr. Thomas Koch  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102607 - Major Field: Vehicle Technology  
M-MACH-102623 - Major Field: Fundamentals of Energy Technology  
M-MACH-102627 - Major Field: Energy Converting Engines  
M-MACH-102635 - Major Field: Engineering Thermodynamics  
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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

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<td>CO2-neutral combustion engines and their fuels I</td>
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<td>Each winter term</td>
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**Competence Certificate**

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

**Prerequisites**

none

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

**CO2-neutral combustion engines and their fuels I**  
2133113, WS 21/22, 4 SWS, Language: German, [Open in study portal](#)

**Content**

- Introduction, Presentation of IFKM  
- Working Principle  
- Characteristic Parameters  
- Engine Parts  
- Drive Train  
- Fuels  
- Gasoline Engines  
- Diesel Engines  
- Hydrogen Engines  
- Exhaust Gas Emissions

**Organizational issues**

Übungstermine Donnerstags nach Bekanntgabe in der Vorlesung
10.55 Course: CO2-Neutral Combustion Engines and their Fuels II [T-MACH-111560]

**Responsible:** Prof. Dr. Thomas Koch

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-102627 - Major Field: Energy Converting Engines
- M-MACH-102635 - Major Field: Engineering Thermodynamics
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

<table>
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**Events**

| ST 2021   | 2134151 | CO2-neutral combustion engines and their fuels II | 3 SWS | Lecture / Practice ( / ) | Koch |

**Exams**

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

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

**Competence Certificate**
oral examination, duration: 25 minutes, no auxiliary means

**Prerequisites**
none

**Recommendation**
Fundamentals of Combustion Engines II helpful

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

<table>
<thead>
<tr>
<th>CO2-neutral combustion engines and their fuels II</th>
<th>Lecture / Practice (VÜ)</th>
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<tr>
<td>2134151, SS 2021, 3 SWS, Language: German, Open in study portal</td>
<td>Blended (On-Site/Online)</td>
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</table>
Course: Coal Fired Power Plants [T-MACH-105410]

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

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102610 - Major Field: Power Plant Technology

<table>
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Competence Certificate
Oral examination, Duration approximately 30 Minutes
no tools or reference materials may be used during the exam

Prerequisites
none
10.57 Course: Cognitive Automobiles - Laboratory [T-MACH-105378]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102598 - Major Field: Advanced Mechatronics  
M-MACH-102609 - Major Field: Cognitive Technical Systems  
M-MACH-102633 - Major Field: Robotics  
M-MACH-102640 - Major Field: Technical Logistics

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**Events**

| ST 2021   | 2138341 | Cognitive Automobiles - Laboratory | 3 SWS | | Stiller, Lauer, Kamran |

**Exams**

| ST 2021 | 76-T-MACH-105378 | Cognitive Automobiles - Laboratory | | Stiller |

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

**Competence Certificate**

oral exam  
30 minutes

**Prerequisites**

none

**Annotation**

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

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

**Cognitive Automobiles - Laboratory**

2138341, SS 2021, 3 SWS, Language: German, Open in study portal

Blended (On-Site/Online)

**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.
# 10.58 Course: Cognitive Systems [T-INFO-101356]

**Responsible:** Prof. Dr. Gerhard Neumann  
Prof. Dr. Alexander Waibel  
**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-102609 - Major Field: Cognitive Technical Systems

<table>
<thead>
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<td>Lecture / Practice</td>
<td>Waibel, Stüker, Neumann</td>
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**Exams**

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<td>WT 21/22</td>
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<td>Waibel, Neumann</td>
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Legend: ☭ Online, ☞ Blended (On-Site/Online), ☀ On-Site, ✗ Cancelled
10.59 Course: Combined Cycle Power Plants [T-MACH-105444]

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

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102610 - Major Field: Power Plant Technology  
- M-MACH-102636 - Major Field: Thermal Turbomachines

<table>
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**Events**

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<td>ST 2021</td>
<td>76-T-MACH-105444 Combined Cycle Power Plants</td>
<td></td>
<td>Schulenberg</td>
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</table>

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

**Prerequisites**  
none

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

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

### Combined Cycle Power Plants

**2170490, SS 2021, 2 SWS, Language: English, Open in study portal**

**Lecture (V) Online**

**Content**

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

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

**Literature**

Die gezeigten Vorlesungsfolien und weiteres Unterrichtsmaterial werden bereitgestellt.

Ferner empfohlen:

## 10.60 Course: Combustion Diagnositics [T-MACH-105429]

**Responsible:** Prof. Dr. Ulrich Maas  
Dr.-Ing. Robert Schießl

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102635 - Major Field: Engineering Thermodynamics

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### Events

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<td>Combustion diagnostics</td>
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### Exams

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<th>76-T-MACH-105429</th>
<th>Combustion Diagnositics</th>
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</table>

**Competence Certificate**  
Oral exam, approx. 20 min

**Prerequisites**  
none

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

### Combustion diagnostics

**2167048, SS 2021, 2 SWS, Language: German,** [Open in study portal](#)

**Content**  
Diagnostical methods: Laser induced fluorescence, Rayleigh-scattering, Raman-scattering Chemoluminescence.  
Reduced description of combustion processes and measurements.  
Discussion of the potential and limits of specific strategies in different combustion systems.

**Organizational issues**  
Termin siehe Aushang im Schaukasten und Internetseite des Instituts.

**Literature**  
Skriptum zur Vorlesung  

### Combustion diagnostics

**2167048, WS 21/22, 2 SWS, Language: German,** [Open in study portal](#)

**Content**  
Analysis of the potential and limits of specific strategies in different combustion systems.
Literature
Skriptum zur Vorlesung
10.61 Course: Combustion Engines I [T-MACH-102194]

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

Organisation:  KIT Department of Mechanical Engineering

Part of:  
M-MACH-102599 - Major Field: Powertrain Systems  
M-MACH-102607 - Major Field: Vehicle Technology  
M-MACH-102630 - Major Field: Mobile Machines

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<td>CO2-neutral combustion engines and their fuels I</td>
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Legend:  🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🗙 Cancelled

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

Prerequisites
none

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

CO2-neutral combustion engines and their fuels I
2133113, WS 21/22, 4 SWS, Language: German, [Open in study portal]

Lecture / Practice (VÜ)  On-Site

Content
Introduction, Presentation of IFKM
Working Principle
Characteristic Parameters
Engine Parts
Drive Train
Fuels
Gasoline Engines
Diesel Engines
Hydrogen Engines
Exhaust Gas Emissions

Organizational issues
Übungstermine Donnerstags nach Bekanntgabe in der Vorlesung
10.62 Course: Combustion Engines II [T-MACH-104609]

**Responsible:** Dr.-Ing. Rainer Koch  
Dr.-Ing. Heiko Kubach  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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<td>Lecture / Practice ( / )</td>
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**Competence Certificate**  
oral examination, duration: 25 minutes, no auxiliary means

**Prerequisites**  
none

**Recommendation**  
Fundamentals of Combustion Engines I helpful

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

**CO2-neutral combustion engines and their fuels II**  
2134151, SS 2021, 3 SWS, Language: German, Open in study portal  
Lecture / Practice (VÜ)  
Blended (On-Site/Online)
10.63 Course: Communication Systems and Protocols [T-ETIT-101938]

**Responsible:** Dr.-Ing. Jens Becker  
Prof. Dr.-Ing. Jürgen Becker

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

**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

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**Prerequisites**

none
10.64 Course: Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies [T-MACH-105535]

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

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-102628 - Major Field: Lightweight Construction
- M-MACH-102632 - Major Field: Polymer Engineering
- M-MACH-102641 - Major Field: Rail System Technology

Events

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Events:

- **ST 2021** 2114053 Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies
  - Type: Lecture / 🖥
  - Responsible: Henning

Exams:

- **ST 2021** 76-T-MACH-105535 Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies
  - Responsible: Henning

- **WT 21/22** 76-T-MACH-105535 Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies
  - Responsible: Henning

Competence Certificate

written exam 90 minutes

Prerequisites

none

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

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

2114053, SS 2021, 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]


### 10.65 Course: Computational Dynamics [T-MACH-105349]

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

**Part of:**  
- M-MACH-102604 - Major Field: Computational Mechanics  
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics  
- M-MACH-102646 - Major Field: Applied Mechanics  
- M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics  
- M-MACH-104443 - Major Field: Vibration Theory

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**Events**

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**Competence Certificate**

oral exam, 30 min.

**Prerequisites**

none

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

#### Computational Dynamics

2162246, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**

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

**Organizational issues**

Fr., 15:45-17:15, Geb. 10.91, Grashof-Hörsaal

**Literature**

1. Ein Vorlesungsskript wird bereitgestellt!  

#### Computational Dynamics

2162246, WS 21/22, 2 SWS, Language: German, Open in study portal

**Content**

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

**Literature**

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

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

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102646 - Major Field: Applied Mechanics  
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

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**Events**

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<td>(Tutorial)</td>
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**Competence Certificate**  
oral exam, 30 min

**Prerequisites**  
nein

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

**Computational homogenization on digital image data (Lecture)**  
2161123, WS 21/22, 2 SWS, Language: English, Open in study portal  
Lecture (V)  
Blended (On-Site/Online)

**Content**

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

**Literature**  

**Computational homogenization on digital image data (Tutorial)**  
2161124, WS 21/22, 2 SWS, Language: English, Open in study portal  
Practice (Ü)  
Blended (On-Site/Online)

**Content**

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

- **Responsible:** apl. Prof. Dr. Ralf Mikut  
  Dr. Ines Reinartz  
  apl. Prof. Dr. Markus Reischl
- **Organisation:** KIT Department of Mechanical Engineering
- **Part of:**  
  - M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
  - M-MACH-102598 - Major Field: Advanced Mechatronics  
  - M-MACH-102601 - Major Field: Automation Technology  
  - M-MACH-102609 - Major Field: Cognitive Technical Systems  
  - M-MACH-102614 - Major Field: Mechatronics  
  - M-MACH-102615 - Major Field: Medical Technology  
  - M-MACH-102624 - Major Field: Information Technology  
  - M-MACH-102633 - Major Field: Robotics

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#### Exams

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

### Competence Certificate

**Written exam (Duration: 1h)**

### Prerequisites

none

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

#### Computational Intelligence

**2105016, WS 21/22, 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

### 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
Kroll, A. Computational Intelligence: Eine Einführung in Probleme, Methoden und technische Anwendungen Oldenbourg Verlag, 2013
Mikut, R.: Data Mining in der Medizin und Medizintechnik. Universitätsverlag Karlsruhe; 2008 (PDF frei im Internet)
### Course: Computational Mechanics I [T-MACH-105351]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102604 - Major Field: Computational Mechanics  
M-MACH-102646 - Major Field: Applied Mechanics

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), ⚫ On-Site, ✗ Canceled

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

**Prerequisites**  
none

**Recommendation**  
The contents of the lectures "Mathematical Methods in Strength of Materials" and "Introduction to the Finite Element Method" are assumed to be known  
This course is geared to MSc students.

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

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

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

**Literature**  
Siehe Literaturhinweise Vorlesung "Rechnerunterstützte Mechanik I".

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

**Literature**  
10 COURSES

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

10.69 Course: Computational Mechanics II [T-MACH-105352]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102604 - Major Field: Computational Mechanics
- M-MACH-102646 - Major Field: Applied Mechanics

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**Events**

| ST 2021   | 2162206 | Consultation hour Computational Mechanics II | 2 SWS | Consultation-hour (Sprechst. / 📱) | Erdle, Krause |
| ST 2021   | 2162296 | Computational Mechanics II                    | 2 SWS | Lecture / 📱                       | Böhlke, Langhoff |
| ST 2021   | 2162297 | Tutorial Computational Mechanics II           | 2 SWS | Practice / 📱                      | Erdle, Krause, Langhoff |

**Exams**

| ST 2021   | 76-T-MACH-105352 | Computational Mechanics II | Böhlke, Langhoff |

**Competence Certificate**

oral examination, 30 min.

**Prerequisites**

none

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

**V** Computational Mechanics II

2162296, SS 2021, 2 SWS, Language: German, [Open in study portal]

**Content**

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

**Organizational issues**

Diese Lehrveranstaltung (gemeinsam mit der begleitenden Studienleistung "Übung zu Rechnerunterstützte Mechanik II") wird im SS 2021 als Blockveranstaltung angeboten. Bitte beachten Sie die Aushänge am Institut und auf der Homepage.

**Literature**


**V** Tutorial Computational Mechanics II

2162297, SS 2021, 2 SWS, Language: German, [Open in study portal]

**Content**

see lecture "Computational Mechanics II"

**Organizational issues**

siehe Vorlesung "Rechnerunterstützte Mechanik II"

**Literature**

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

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102641 - Major Field: Rail System Technology
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics

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

Events

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<tr>
<th>ST 2021</th>
<th>2162256</th>
<th>Computational Vehicle Dynamics</th>
<th>2 SWS</th>
<th>Lecture / Online</th>
<th>Proppe</th>
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<tr>
<td>WT 21/22</td>
<td>2162256</td>
<td>Computational Vehicle Dynamics</td>
<td>2 SWS</td>
<td>Lecture / Online</td>
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Exams

| ST 2021 | 76-T-MACH-105350 | Computational Vehicle Dynamics | Proppe |

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

Competence Certificate
oral exam, 30 min.

Prerequisites
none

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

Computational Vehicle Dynamics
2162256, SS 2021, 2 SWS, Language: German, Open in study portal

Content
This course serves as an introduction into the computational modelling and simulation of technical system road/vehicle. A method based perspective is taken which allows for a unified treatment of various kinds of vehicles. The vehicle model is obtained by dividing the system into functional subsystems and defining interfaces between these subsystems.

In the first part of the course, vehicle models will be developed based on models of the suspensions, the road, and the contact forces between road and vehicle. The focus of the second part of the course is on computational methods for linear and non-linear models of vehicle systems. The third part of the course discusses design criteria for stability, safety and ride comfort. Multibody dynamics simulations will be carried out using Matlab/ Simulink.

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

Literature

Computational Vehicle Dynamics
2162256, WS 21/22, 2 SWS, Language: German, Open in study portal
Content
This course serves as an introduction into the computational modelling and simulation of technical system road/vehicle. A method based perspective is taken which allows for a unified treatment of various kinds of vehicles. The vehicle model is obtained by dividing the system into functional subsystems and defining interfaces between these subsystems.

In the first part of the course, vehicle models will be developed based on models of the suspensions, the road, and the contact forces between road and vehicle. The focus of the second part of the course is on computational methods for linear and non-linear models of vehicle systems. The third part of the course discusses design criteria for stability, safety and ride comfort. Multibody dynamics simulations will be carried out using Matlab/Simulink.

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

Literature
10.71 Course: Computerized Multibody Dynamics [T-MACH-105384]

**Responsible:** Prof. Dr.-Ing. Wolfgang Seemann

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
- M-MACH-102633 - Major Field: Robotics
- M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics

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

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

**Prerequisites**
none

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

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering

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Events

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<td>2 SWS</td>
<td>Lecture / 👤</td>
<td>Ulrich</td>
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<td>2177601</td>
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<td>Constitution and Properties of Protective Coatings</td>
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Exams

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<th>Version</th>
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<td>Lecture / 👤</td>
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<td>76-T-MACH-105150</td>
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<td>Constitution and Properties of Protective Coatings</td>
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</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 👤 On-Site, x Cancelled

Competence Certificate
oral examination (about 30 min)

no tools or reference materials

Prerequisites
none

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

Constitution and Properties of Protective Coatings
2177601, WS 21/22, 2 SWS, Language: German, Open in study portal

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

Teaching Content:
introduction and overview

concepts of surface modification

coating concepts

coating materials

methods of surface modification

coating methods

characterization methods

state of the art of industrial coating of tools and components

new developments of coating technology

regular attendance: 22 hours

self-study: 98 hours

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

Recommendations: none
Organizational issues
Achtung: Die Vorlesung beginnt erst am Donnerstag, 28.10.2021
Falls die Vorlesung online stattfinden muss, bitte um Anmeldung unter sven.ulrich@kit.edu bis zum 10.10.21.
Den entsprechenden MS Teams Link erhalten Sie dann per E-Mail am 11.10.21.

Literature

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

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

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102611 - Major Field: Materials Science and Engineering
- M-MACH-102637 - Major Field: Tribology

Type
- Oral examination

Credits
- 4

Grading scale
- Grade to a third

Recurrence
- Each summer term

Version
- 3

Events

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<td>Constitution and Properties of Wear resistant materials</td>
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Exams

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<td>Constitution and Properties of Wearresistant Materials</td>
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<td>WT 21/22</td>
<td>76-T-MACH-102141</td>
<td>Constitution and Properties of Wearresistant Materials</td>
<td>Ulrich</td>
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</table>

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

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

Prerequisites
- none

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

Constitution and Properties of Wear resistant materials
2194643, SS 2021, 2 SWS, Language: German, Open in study portal

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

Teaching Content:
introduction
materials and wear
unalloyed and alloyed tool steels
high speed steels
stellites and hard alloys
hard materials
hard metals
ceramic tool materials
superhard materials
new developments
regular attendance: 22 hours
self-study: 98 hours
Basic understanding of constitution of wear-resistant materials, of the relations between constitution, properties and performance, of principles of increasing of hardness and toughness of materials as well as of the characteristics of the various groups of wear-resistant materials.
Recommendations: none

Organizational issues
Aufgrund der aktuellen Situation findet die Blockveranstaltung online in folgendem Zeitraum statt:
06.04.-08.04.2021: jeweils von 8:00-16:00 Uhr;
Ort: online per MS-Teams
Anmeldung verbindlich bis zum 02.04.2021 unter sven.ulrich@kit.edu.
Nach der Anmeldung wird Ihnen der Link zur Vorlesung per E-Mail am 05.04.2021 mitgeteilt.

Literature
Schneider, J.: Schneidkeramik, Verlag moderne Industrie, Landsberg am Lech, 1995
Kopien der Abbildungen und Tabellen werden verteilt; Copies with figures and tables will be distributed
10.74 Course: Contact Mechanics [T-MACH-105786]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102637 - Major Field: Tribology

<table>
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<th>Version</th>
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Events

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<td>Exams</td>
<td>76-T-MACH-105786</td>
<td>Greiner</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
none

Recommendation
preliminary knowledge in mathematics, physics and materials science

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

Contact Mechanics
2181220, SS 2021, 2 SWS, Language: German, [Open in study portal]

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
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
Organizational issues
Weitere Informationen finden Sie in ILIAS.
Kontakt: christian.greiner@kit.edu

Literature
K. L. Johnson, Contact Mechanics (Cambridge University Press, 1985)
D. Maugis, Contact, Adhesion and Rupture of Elastic Solids (Springer-Verlag, 2000)
Course: Contact Mechanics for Dynamic Systems [T-MACH-110834]

Responsible: Dr.-Ing. Ulrich Römer
Organisation: Part of: M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104443 - Major Field: Vibration Theory

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

Events

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<th>ST 2021</th>
<th>2162291</th>
<th>Contact Mechanics for Dynamic Systems</th>
<th>2 SWS</th>
<th>Lecture / 🧩</th>
<th>Römer</th>
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Exams

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<th>ST 2021</th>
<th>76-T-MACH-110834</th>
<th>Contact Mechanics for Dynamic Systems</th>
<th>Römer</th>
</tr>
</thead>
</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗑 On-Site, ❌ Cancellation

Competence Certificate
oral examination (duration 20 min.)

Prerequisites
none

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

Contact Mechanics for Dynamic Systems
2162291, SS 2021, 2 SWS, Language: German, Open in study portal

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

Content
Geometric description of contacts between two or more objects.
Description of dynamic systems with unilateral contacts and/or friction by means of complementarity problems.
Different solution methods, their advantages and disadvantages and physical interpretation.
Special difficulties (existence & uniqueness of solutions) for non-smooth dynamical systems.
Nonlinearities due to elastic contacts (Hertz contact) and friction (Stribeck curve).
Influence of contact nonlinearities on vibrations of simple mechanical systems.

Learning objectives:
Students can describe dynamic systems with contacts, especially one-sided bonds and static-sliding friction transitions, mathematically. They are able to explain the complementarity problems that arise in this context and explain various methods for solving them as well as their advantages and disadvantages. The students can name difficulties in solving them and explain their causes and effects. They can explain the effects of contact nonlinearities on the vibrations of simple mechanical systems and calculate them.

Literature
Literatureempfehlungen in der Vorlesung/in den Vorlesungsunterlagen.
10.76 Course: Continuum Mechanics of Solids and Fluids [T-MACH-110377]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102628 - Major Field: Lightweight Construction  
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

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

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<tr>
<td>WT 21/22</td>
<td>2161252</td>
<td>Continuum mechanics of solids and fluids</td>
<td>Lecture / 🧩</td>
<td>2 SWS</td>
<td>Grade to a third</td>
<td>Each winter term</td>
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**Exams**

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<td>Continuum mechanics of solids and fluids</td>
<td>Lecture (V)</td>
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<td>Böhlke, Frohnapfel</td>
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**Competence Certificate**
Written examination (90 min). Additives as announced

**Prerequisites**

passing the corresponding "Tutorial Continuum Mechanics of Solids and Fluids" (T-MACH-110333)

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-110333 - Tutorial Continuum Mechanics of Solids and Fluids must have been passed.

**Annotation**

Due to capacity reasons it is possible that not all students of this course can be admitted to the computer tutorials. Students of the bachelor's degree program in mechanical engineering who have chosen the Major Field Continuum Mechanics (SP-Nr 13) and students of the bachelor's degree program in material science and material technology will be admitted to the computer tutorials in any case.

If additional places are available in the computer tutorials for this course, these will be allocated according to the BSc average grade.

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

**Continuum mechanics of solids and fluids**

<table>
<thead>
<tr>
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<td>WS 21/22</td>
<td>2 SWS</td>
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**Lecture (V)**

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</table>

**Content**

- introduction into tensor calculus  
- kinematics  
- balance laws of mechanics and thermodynamics  
- material theory of solids and fluids  
- field equations for solids and fluids  
- thermomechanical couplings  
- dimensional analysis

**Literature**

Vorlesungsskript
Schade, H.: Strömungslehre, de Gruyter 2013
10.77 Course: Control Technology [T-MACH-105185]

**Responsible:** Hon.-Prof. Dr. Christoph Gönnheimer  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102599 - Major Field: Powertrain Systems  
M-MACH-102601 - Major Field: Automation Technology  
M-MACH-102618 - Major Field: Production Technology  
M-MACH-102624 - Major Field: Information Technology  
M-MACH-102633 - Major Field: Robotics

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**Events**

| ST 2021 | 2150683 | Control Technology | 2 SWS | Lecture / Online | Gönnheimer |

**Exams**

| ST 2021 | 76-T-MACH-105185 | Control Technology | Gönnheimer |

Legend: 🌐 Online, 🏠 Blended (On-Site/Online), 🗣 On-Site, ☑️ Cancelled

**Competence Certificate**

Written Exam (60 min)

**Prerequisites**

none

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

**Control Technology**

2150683, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

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

The lecture is very practice-oriented and illustrated with numerous examples from different branches.

The following topics will be covered:

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

Learning Outcomes:
The students ...

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

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

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

Media:
Lecture notes will be provided in ilias (https://ilias.studium.kit.edu/).
Course: Cooling of Thermally High Loaded Gas Turbine Components [T-MACH-105414]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102610 - Major Field: Power Plant Technology  
M-MACH-102636 - Major Field: Thermal Turbomachines

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

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<th>2 SWS</th>
<th>Lecture / 🧩</th>
<th>Bauer</th>
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<td>2 SWS</td>
<td>Lecture / 🧩</td>
<td>Bauer, Schulz</td>
</tr>
</tbody>
</table>

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

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

**Prerequisites**
none

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

**Cooling of thermally high loaded gas turbine components**

2170463, SS 2021, 2 SWS, Language: German, [Open in study portal]

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

**Exam:**
oral  
Duration: approximately 30 minutes

The students are able to:

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

**Exams**

<table>
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<tr>
<th>ST 2021  76-T-MACH-105414</th>
<th>2 SWS</th>
<th>Lecture (V) / 🧩</th>
<th>Bauer</th>
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<td>2 SWS</td>
<td>Lecture (V) / 🧩</td>
<td>Bauer, Schulz</td>
</tr>
</tbody>
</table>

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

**Regular attendance:** 21 h  
**Self-study:** 42 h

The students are able to:

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

**Exam:**
oral  
Duration: approximately 30 minutes

no tools or reference materials may be used during the exam
10.79 Course: Current Topics on BioMEMS [T-MACH-102176]

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

Part of: M-MACH-102616 - Major Field: Microsystem Technology

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Exams

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<td>Seminar / Guber</td>
<td>Examination of another type</td>
<td>Each term</td>
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<td>2 SWS</td>
<td>Seminar / Guber</td>
<td>Examination of another type</td>
<td>Each term</td>
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</table>

Competence Certificate
active participation and own presentation (30 Min.)

Prerequisites
none

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

**Actual topics of BioMEMS**
2143873, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**
- Short introduction to the basics of BioMEMS
- Selected aspects of biomedical engineering and life sciences
- Possible micro technical manufacturing processes
- Selected application examples from research and industry

The seminar includes (bio)medical engineering as well as biological and biotechnological topics in the context of engineering sciences
- Use of microtechnical components and systems in innovative medical products
- Use of microfluidic chip systems in applied biology and biotechnology

**Organizational issues**
Siehe Aushang

**Actual topics of BioMEMS**
2143873, WS 21/22, 2 SWS, Language: German, Open in study portal

**Organizational issues**
Wird bekannt gegeben
10 COURSES
Course: Data Analytics for Engineers [T-MACH-105694]

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

- **Responsible:** Stefan Meisenbacher
  - apl. Prof. Dr. Ralf Mikut
  - apl. Prof. Dr. Markus Reischl
- **Organisation:** KIT Department of Mechanical Engineering
- **Part of:**
  - M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
  - M-MACH-102598 - Major Field: Advanced Mechatronics
  - M-MACH-102601 - Major Field: Automation Technology
  - M-MACH-102609 - Major Field: Cognitive Technical Systems
  - M-MACH-102614 - Major Field: Mechatronics
  - M-MACH-102615 - Major Field: Medical Technology
  - M-MACH-102624 - Major Field: Information Technology
  - M-MACH-102633 - Major Field: Robotics

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**Events**

- **Events**
  - ST 2021: 2106014 Data Analytics for Engineers 3 SWS Lecture / Practice ( / Mikut, Reischl, Meisenbacher

**Exams**

- **Exams**
  - ST 2021: 76-T-MACH-105694 Datenanalyse für Ingenieure Mikut, Reischl
  - WT 21/22: 76-T-MACH-105694 Data Analytics for Engineers Mikut

**Legend:** ![Online](.), ![Blended (On-Site/Online)](), ![On-Site](.), ![Cancelled](.)

**Competence Certificate**

Written exam (Duration: 1h)

**Prerequisites**

none

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

**Data Analytics for Engineers**

- **Data Analytics for Engineers**
  - 2106014, SS 2021, 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): 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.
Literatur
Vorlesungsunterlagen (ILIAS)
Mikut, R.: Data Mining in der Medizin und Medizintechnik. Universitätsverlag Karlsruhe.
2008 (PDF frei im Internet)
10.81 Course: Data Driven Engineering 1: Machine Learning for Dynamical Systems [T-MACH-111193]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102609 - Major Field: Cognitive Technical Systems
- M-MACH-102610 - Major Field: Power Plant Technology
- M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology
- M-MACH-102624 - Major Field: Information Technology
- M-MACH-102635 - Major Field: Engineering Thermodynamics
- M-MACH-102636 - Major Field: Thermal Turbomachines
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering

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**Events**

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**Exams**

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<td>Data Driven Engineering 1: Machine Learning for Dynamical Systems</td>
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<td>Ates</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**

Oral exam, approximately 30 minutes

**Prerequisites**

None

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

**V** Data Driven Engineering 1: Machine Learning for Dynamical Systems

2169556, WS 21/22, 2 SWS, Language: English, Open in study portal

Lecture (V) Online
Content
This course focuses on the fundamentals of intelligence and machine learning (ML) methodologies that can be utilized to solve engineering problems. The course is devoted to diploma/master students and doctoral candidates of mechanical and chemical engineering and environmental sciences. Throughout the semester, students will build up the basic skills needed to develop intelligent solutions for pattern recognition in experimental/numerical datasets, model abstractions, optimization and process control. Another objective is to establish a strong scientific background in order to clarify the current capabilities, challenges and opportunities in ML. The course includes weekly software sessions in TensorFlow for hands-on experience and finalizes with an End-to-End Machine Learning Project.

Contents:
1. Introduction to Data Driven Engineering
2. Basics of Learning
3. Analysis of Static Datasets I: Classification and Regression
4. Analysis of Static Datasets II: Clustering and Dimensionality Reduction
5. Deep Learning for Dynamical Systems
6. Sequence Modeling
7. Generative Modeling
8. Machine Learning Control
9. Emerging Concepts and the Outlook
10. Project Sessions

Lecture Format:
- Lectures: 45 min; Practice hours: 45 minutes

Workload:
- Regular attendance: 21 hours
- Self-study: 42 hours

Learning Objectives:
Students have the ability to:
- distinguish between different learning methods (information, similarity, probability, error-based) and select suitable strategies and algorithms accordingly,
- explore large datasets, handle data quality issues and prepare it for downstream applications,
- explain the procedures of ML algorithms,
- judge and apply different approaches to analyze static datasets,
- analyze and evaluate methods for large dynamical systems via deep learning,
- plan and execute an end-to-end machine learning project from data collection to launch phase,
- design recipes for a given problem and to solve practical engineering problems with ML.

Organizational issues
siehe auch Internetseite des Instituts
Vorlesung wird in Präsenz angeboten, sofern die COVID-Inzidenzwerte es zulassen.

Literature
Lecture notes
10.82 Course: Data Driven Engineering 2: Advanced Topics [T-MACH-111373]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102609 - Major Field: Cognitive Technical Systems
- M-MACH-102610 - Major Field: Power Plant Technology
- M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology
- M-MACH-102624 - Major Field: Information Technology
- M-MACH-102636 - Major Field: Thermal Turbomachines

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<th>Recurrence Each summer term</th>
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**Events**

| ST 2021 | 2170486 | Data Driven Engineering 2 | 2 SWS | Lecture / Online | Ates |

**Exams**

| ST 2021 | 76-T-MACH-111373 | Data Driven Engineering 2 | Ates |
| WT 21/22 | 76-T-MACH-111373 | Data Driven Engineering 2: Advanced Topics | Ates |

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

**Competence Certificate**

Oral exam, approximately 30 minutes

**Prerequisites**

none

**Recommendation**

The course is intended for students with a strong background and interest in ML applications for engineering problems. It is strongly recommended to be taken in combination with the “Data Driven Engineering 1 Machine Learning for Dynamical Systems” course.

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

**Data Driven Engineering 2**

2170486, SS 2021, 2 SWS, Language: English, [Open in study portal](#)
Content
Data Driven Engineering 2: Advanced Topics
Responsible: Dr. Cihan Ates
Organization: KIT Department of Mechanical Engineering
Type: Oral examination
Credits: 4
Recurrence: Each summer term
Version: 1

Events
SS 20/21
???
Data Driven Engineering II: Advanced Topics
2 SWS
Lecture (V)
Ates

Exams
SS 20/21
???
Data Driven Engineering II: Advanced Topics
Prüfung (PR)
Ates

Competence Certificate: Oral exam, approximately 30 minutes
Prerequisites: None
In this course, we will dive into the details of the most recent applications in data driven engineering within the scope of machine learning (ML). Building upon the skills developed in the “Data Driven Engineering 1: Machine Learning for Dynamical Systems” course, students will learn about complex model architectures through different “themes”, with the objective of providing a deeper background and capability to navigate through the recent developments in the field.

The lecture is integrated with group projects. Students will form groups and be assigned open-ended research problems with scientific mentors at the beginning of the semester. In the following weeks, the groups will work on their problems by combining the fundamental skills they gained in the first and second lectures. The progress will be monitored via project sessions throughout the semester. The finalized work will be presented at the end of the semester and published in the lecture repository.

Contents:
1. Introduction to the lecture and project workflow
2. Data-driven image processing for fluid mechanics
3. Dynamic Mode Decomposition and coordinate transformations
4. Modelling of transport phenomena with neural networks
5. State space models
6. Integration of genetic algorithms with machine learning
7. ML-Augmented Experiment Design and Machine Learning Control
8. Project presentations

Lecture Format:
- Lectures: 45 min; Practice hours: 45 minutes
- Project sessions: 90 minutes

Workload:
- Regular attendance: 21 hours
- Self-study: 42 hours

Learning Objectives:
Students have the ability to:
- explain the underlying mathematics of ML algorithms,
- tailor data-driven methods on open-ended engineering problems,
- tackle challenges for complex, hybrid architectures,
- describe and apply various architectures for specialized domains such as flow visualization, transport phenomena, experiment design,
- extract patterns and correlate them with the physics of the problem for dynamical datasets,
- navigate through the recent developments in the field,
• plan and conduct research projects in groups.

Recommendations:
The course is intended for students with a strong background and interest in ML applications for engineering problems. It is strongly recommended to be taken in combination with the “Data Driven Engineering 1 Machine Learning for Dynamical Systems” course.
### 10.83 Course: Data Science and Scientific Workflows [T-MACH-111588]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102649 - Major Field: Advanced Materials Modelling

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**Competence Certificate**  
written exam

**Prerequisites**  
T-MACH-111603 must have been passed

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

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

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102649 - Major Field: Advanced Materials Modelling

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<td>pass/fail</td>
<td>Each summer term</td>
<td>1</td>
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**Competence Certificate**  
Successfully create a functional programme/workflow and documentation.

**Prerequisites**  
none
10.85 Course: Decently Controlled Intralogistic Systems [T-MACH-105230]

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

Part of: M-MACH-102591 - Laboratory Course

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

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Exams

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

Competence Certificate  
Certificate by colloquium with presentation

Prerequisites  
None

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

![Practical course (P) Online](V Decently controlled intralogistic systems 2117084, SS 2021, 2 SWS, Language: German, Open in study portal)
Content

Requirements:
Duty of attendance

Recommendations:
-

Media:
Lego Mindstorms, PC

Teaching content:

- Introduction to intralogistic systems
- Development of a model of a decentralized logistics system
- Object-oriented programming of the control with LabView
- Implementation of the model in Mindstorms
- Presentation of work results

Note:

Limited number of participants (max. 15 students per group, under CORONA-conditions max. 8 students per group)
Selection is made according to a selection procedure
A passage in English language can be offered if required

Workload:
attendance time: 90 hours (workstation is provided)
Self-study: 30 hours

Educational goal:
The students can:

- name and explain the basics of intralogistic conveyor systems
- describe and explain communication types between decentralized systems
- apply the basics of project management in subsequent projects
- dealing with the graphical based software development environment LabView
- developing constructive solutions for mechanical problems
- applying the theory learned to a practical problem
- evaluate solutions developed through group discussions and presentations
- examination:

Examination:
Certificate by colloquium with lecture, documentation of work results and by fulfilling the attendance obligation

Organizational issues
Termine im SS21:
Gruppe 1 (Maximilian Ries) 23.08.2021 - 03.09.2021
Gruppe 2 (Marvin Sperling) 06.09.2021 - 17.09.2021

*Corona-bedingte Änderungen vorbehalten*

Literature
keine
Content

Proof:

- Certificate by colloquium with presentation

Note:

- Number of participants limited
- Participants will be selected
- Compulsory attendance

Media:

- Lego Mindstorms, PC

Teaching content:

- Introduction to material handling systems
- Construction of a model for decentralized logistic systems
- Object-oriented programming with LabView (or Python* with reservation)
- Implementation of the model with Mindstorms
- Presentation of the results

Learning objectives:

Students are able to:

- Model complex cinematic systems and use object-oriented programming for this purpose,
- Built experimental setups in a team for decentralized controlled intralogistic systems, choose appropriate system components and models and finally proof the function by using experiments.

Effort:

- Regular attendance: 90 hours (workplace is provided)
- Self-study: 30 hours

Dates and further information see homepage

Organizational issues

Termine im WS21/22:

Gruppe 1 (Maximilian Ries) 07.02.- 25.02.2022, davon Präsenz: 07.02., 14.02. - 25.02.2022
Gruppe 2 (Marvin Sperling) 21.02.- 11.03.2022, davon Präsenz: 21.02., 28.02. - 11.03.2022

Anmeldezeitraum:

01.11.2021 8:00 Uhr - 30.11.2021 18:00 Uhr (via Ilias-Kurs)

*Corona-bedingte Änderungen vorbehalten*

Literature

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

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102605 - Major Field: Engineering Design
- M-MACH-102630 - Major Field: Mobile Machines

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

| WT 21/22 | 2113079 | Design and Development of Mobile Machines | 2 SWS | Lecture / 📝 | Geimer, Lehr |

**Exams**

| ST 2021 | 76-T-MACH-105311 | Design and Development of Mobile Machines | Geimer |
| WT 21/22 | 76-T-MACH-105311 | Design and Development of Mobile Machines | Geimer |

**Legend:** Online, 📝 Blended (On-Site/Online), 🗺 On-Site, 🗤 Cancelled

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

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

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

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

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

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

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

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

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

The number of participants is limited.

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

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

**Design and Development of Mobile Machines**

2113079, WS 21/22, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

Blended (On-Site/Online)

**Content**

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

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

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

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

**Recommendations:**

Knowledge in Fluid Technology (SoSe, LV 21093)

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

**Literature**

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

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102605 - Major Field: Engineering Design
- M-MACH-102630 - Major Field: Mobile Machines

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**Exams**

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<tr>
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<td>Design and Development of Mobile Machines - Advance</td>
<td>Geimer</td>
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<td>76-T-MACH-108887</td>
<td>Design and Development of Mobile Machines - Advance</td>
<td>Geimer</td>
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**Competence Certificate**
Preparation of semester report

**Prerequisites**
none
10.88 Course: Design and Optimization of Conventional and Electrified Automotive Transmissions [T-MACH-110958]

Responsible: Prof. Dr.-Ing. Albert Albers  
Dr.-Ing. Hartmut Faust

Organisation: KIT Department of Mechanical Engineering

Part of:  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102599 - Major Field: Powertrain Systems  
M-MACH-102607 - Major Field: Vehicle Technology

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Events

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<td>Design and Optimization of Conventional and Electrified Automotive Transmissions</td>
<td>2 SWS</td>
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Exams

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<tr>
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<td>Design and Optimization of Conventional and Electrified Automotive Transmissions</td>
<td>Faust, Albers</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate
oral exam (20 min)

Prerequisites
none

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

Design and Optimization of Conventional and Electrified Automotive Transmissions
2146208, SS 2021, 2 SWS, Language: German, Open in study portal

Content

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


Lernziele

Die Studenten erwerben das Wissen aus aktuellen Getriebe-, Hybrid- und reinen Elektroantriebs-Entwicklungen über …

- die Funktionsweise und Auslegung von konventionellen und elektrifizierten Fahrzeuggetrieben und deren Komponenten;
- Konstruktions- und Funktionsprinzipien der wichtigsten Komponenten von Handschalt-, Doppelkupplungs-, stufenlosen und Planetenautomat-Getrieben;
- komfortrelevante Zusammenhänge und Abhilfemaßnahmen;
- die Hybridisierung und Elektrifizierung der Triebstränge auf Basis bekannter Getriebetypen und mit speziellen sogenannten Dedicated Hybrid Transmissions (DHT) sowie Bewertung der Konzepte auf Systemebene.
10.89 Course: Design of a Jet Engine Combustion Chamber [T-CIWVT-105780]

**Responsible:** Prof. Dr.-Ing. Nikolaos Zarzalis

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** M-MACH-102627 - Major Field: Energy Converting Engines

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**Events**

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Legend: 📥 Online, 🧱 Blended (On-Site/Online), 🗣 On-Site, ☓ Cancelled

**Competence Certificate**

The examination is an oral examination on lecture 22527 with a duration of 20 minutes.

**Prerequisites**

None
10.90 Course: Design of Fuel Cell Systems [T-MACH-111398]

**Responsible:** Dr.-Ing. Jan Haußmann

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102599 - Major Field: Powertrain Systems
- M-MACH-102605 - Major Field: Engineering Design
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology

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

| WT 21/22 | 2145200 | Design of fuel cell systems | 2 SWS | Lecture / 🔴 | Haußmann |

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

**Competence Certificate**

Oral exam (app. 20 min)

**Prerequisites**

None
10.91 Course: Design of Highly Stresses Components [T-MACH-105310]

**Responsible:** apl. Prof. Dr. Jarir Aktaa

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
- M-MACH-102608 - Major Field: Nuclear Energy
- M-MACH-102610 - Major Field: Power Plant Technology
- M-MACH-102636 - Major Field: Thermal Turbomachines
- M-MACH-102643 - Major Field: Fusion Technology
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

**Events**

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**Exams**

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</table>

**Competence Certificate**
oral exam

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

**Design of highly stresses components**

2181745, WS 21/22, 2 SWS, Language: German, Open in study portal

**Lecture (V) On-Site**

**Content**

Contents of the lecture:
- rules of common design codes
- classical models for elasto-plasticity and creep
- lifetime rules for creep, fatigue and creep-fatigue interaction
- unified constitutive models for thermo-elasto-viscoplasticity
- continuum mechanical models for damage at high temperatures
- application of advanced material models in FE-codes

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

**Qualification:** Materials Science, solid mechanics II

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

**Literature**


10 COURSES

10.92 Course: Design Thinking [T-WIWI-102866]

Responsible: Prof. Dr. Orestis Terzidis
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104323 - Major Field: Innovation and Entrepreneurship

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Events

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<td>Design Thinking (Track 1)</td>
<td>Seminar / Online</td>
<td>González, Abraham, Csernalabics, Manthey</td>
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Exams

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

Competence Certificate

Alternative exam assessments (§4(2), 3 SPO).

Prerequisites

None

Recommendation

None

Annotation

The seminar content will be published on the website of the institute.

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

Design Thinking (Track 1)

2545008, WS 21/22, 2 SWS, Language: English, Open in study portal

Content

Course Content:

Design Thinking is a user-centric innovation management method. The iterative process first analyzes the problem space and builds a sound understanding of the future users. Subsequently, ideas for the solution are generated, prototypes are created and tested by the user group. The result is a proven and validated product.

During the seminar, the students learn basic procedures for achieving user-centric innovations. These are concrete methods that start with the potential user of certain products and services. The method is problem-oriented and emphasizes the specific customer situation. After attending the seminar, the students have a clear understanding of the need to explore end-user needs and are able to independently apply the methods of Design Thinking for developing market-driven innovations at a basic level.

Credentials:

Registration is via the Wiwi portal.

ATTENTION: Creditability in the seminar module: The seminar is NOT credited in the seminar module! Crediting is only possible in the EXPERT MODULE ENTREPRENEURSHIP.
10.93 Course: Design with Plastics [T-MACH-105330]

**Responsible:** Markus Liedel  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102605 - Major Field: Engineering Design  
- M-MACH-102611 - Major Field: Materials Science and Engineering  
- M-MACH-102628 - Major Field: Lightweight Construction  
- M-MACH-102632 - Major Field: Polymer Engineering  
- M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

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**Events**

| ST 2021 | 2174571 | Design with Plastics | 2 SWS | Lecture / X | Liedel |

**Exams**

| ST 2021 | 76-T-MACH-105330 | Design with Plastics | Liedel |

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

**Competence Certificate**

Oral exam, about 20 minutes

**Prerequisites**

none

**Recommendation**

Poly I

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

**Design with Plastics**

2174571, SS 2021, 2 SWS, Language: German, [Open in study portal](#)
Content
Structure and properties of plastics materials,
Processing of plastics,
Behavior of plastics under environmental impacts,
Classic strength dimensioning,
Geometric dimensioning,
Plastic appropriate design,
Failure examples,
Joining of plastic parts,
Supporting simulation tools,
Structural foams,
Plastics Technology trends.

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

requirements:
none,

recommendation: Polymerengineering I

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

Organizational issues

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

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102628 - Major Field: Lightweight Construction

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

Exams
ST 2021 76-T-MACH-108721 Designing with Composites

Competence Certificate
Oral exam, 20 minutes

Prerequisites
None

Annotation
The lecture notes are made available via ILIAS.
**10.95 Course: Designing with numerical methods in product development [T-MACH-108719]**

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

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102605 - Major Field: Engineering Design  
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics  
M-MACH-102607 - Major Field: Vehicle Technology

**Type**  
Oral examination

**Credits**  
4

**Grading scale**  
Grade to a third

**Recurrence**  
Each winter term

**Version**  
1

### Events

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### Exams

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

### Competence Certificate

Oral examination (duration: 20 min)

### Prerequisites

None

### Annotation

The lecture notes are made available via ILIAS.

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

**Designing with numerical methods in product development**  
2161229, WS 21/22, 2 SWS, Language: German, Open in study portal

**Content**


**Organizational issues**

Beginn ab 11.11.2021

**Literature**

Vorlesungsskript
Course: Development of hybrid drivetrains [T-MACH-110817]

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

**Part of:**  
M-MACH-102607 - Major Field: Vehicle Technology  
M-MACH-102627 - Major Field: Energy Converting Engines  
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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**Events**

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<th>Development of Hybrid Powertrains</th>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ⬗ Cancelled

**Competence Certificate**

written exam, 1 hour

**Prerequisites**

None

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

**Development of Hybrid Powertrains**

2134155, SS 2021, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

Blended (On-Site/Online)

**Content**

1. Introduction and Goal  
2. Alternative Powertrains  
3. Fundamentals of Hybrid Powertrains  
4. Fundamentals of Electric Components of Hybrid Powertrains  
5. Interactions in Hybrid Powertrain Development  
6. Overall System Optimization
10.97 Course: Development of Oil-Hydraulic Powertrain Systems [T-MACH-105441]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102599 - Major Field: Powertrain Systems
- M-MACH-102605 - Major Field: Engineering Design
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-102618 - Major Field: Production Technology
- M-MACH-102627 - Major Field: Energy Converting Engines
- M-MACH-102630 - Major Field: Mobile Machines
- M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

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**Events**

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<td>WT 21/22</td>
<td>2113072</td>
<td>Development of Oil-Hydraulic Powertrain Systems</td>
<td>2 SWS</td>
<td>Block /🧬</td>
<td>Geerling, Shenoy</td>
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**Exams**

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

**Competence Certificate**

oral exam (20 min)

**Prerequisites**

none

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

**Development of Oil-Hydraulic Powertrain Systems**

2113072, WS 21/22, 2 SWS, Language: German, Open in study portal

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

**Content**
The block 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
**10.98 Course: Digital Control [T-MACH-105317]**

**Responsible:** Dr.-Ing. Michael Knoop

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102601 - Major Field: Automation Technology
- M-MACH-102609 - Major Field: Cognitive Technical Systems
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102624 - Major Field: Information Technology
- M-MACH-102629 - Major Field: Logistics and Material Flow Theory
- M-MACH-102633 - Major Field: Robotics

**Events**

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<tr>
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<td>2 SWS</td>
<td>Lecture</td>
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<td>Stiller</td>
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**Exams**

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**Legend:** 🖥 Online, 🟢 Blended (On-Site/Online), ⚫ On-Site, ✗ Cancelled

**Competence Certificate**

- written exam
- duration: 60 min.

**Prerequisites**

- none

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

**Digital Control**

2137309, WS 21/22, 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 introduces key methods for the analysis and design of digital feedback control systems. Starting point is the discretisation of linear, continuous-time models. State space based and z-transform based controller design techniques are presented for discrete-time, single-input single-output systems. Furthermore, plants with dead-time and deadbeat design are covered.
- Nachweiss: written examination; duration: 60 minutes; no tools or reference materials may be used during the exam.
- Arbeitsaufwand: 120 hours
Literature

T \textbf{10.99 Course: Digital microstructure characterization and modeling [T-MACH-110431]}

- **Responsible:** Jun.-Prof. Dr. Matti Schneider
- **Organisation:** KIT Department of Mechanical Engineering
- **Part of:**
  - M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
  - M-MACH-102646 - Major Field: Applied Mechanics
  - M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

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**Exams**

| ST 2021 | 76-T-MACH-110431 | Digital microstructure characterization and modeling | Schneider |

**Competence Certificate**

oral examination
10.100 Course: Digital Transformation of Industrial Companies [T-MACH-111298]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102600 - Major Field: Man - Technology - Organisation
- M-MACH-102613 - Major Field: Lifecycle Engineering

<table>
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Events

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

Competence Certificate
oral exam (approx. 30 min)
The exam is offered in German only!

Prerequisites
None.

Recommendation
- Previous knowledge of work and production systems as well as industrial engineering recommended
- Knowledge of labor and economics advantageous

Below you will find excerpts from events related to this course:
Content
Learning objectives:
The ongoing digital Transformation fundamentally changes the conditions and the environment of the industry worldwide. Industrial companies are facing massive socio-technical challenges with the target shaping and implementing the digital Transformation considering individual, holistic, practical and economic aspects. In this course the students especially learn:
Basic knowledge regarding Industrial Engineering, economic design of modern work- and production-systems, applicable Industry 4.0 technologies and their corresponding chances and challenges in a modern work environment (brown- & greenfield)
Keen knowledge regarding industrial companies and their elementary business & process types as a base for a benefit orientated derivation of measures
Ability of maturity estimation for an industrial company, requirements derivation and identification of corresponding potentials for the digital Transformation
Ability of a holistic, individual and economic planning & implementation of the digital Transformation for industrial companies including necessary steps, corresponding methods and guidelines, as well target measurement to ensure value contribution of implemented solutions (e.g. information technology)

Content:
Theoretical background and basics regarding Industrial Engineering, industrial history and existing structures of globally operating industrial companies
Digital Transformation of industrial companies and effects on the work environment
Analysis status quo of corresponding work- and production-systems of industrial companies
Planning of the digital Transformation
Implementation of the digital Transformation incl. Industry 4.0
Target measurement and conclusions in practice

Organizational:
Compulsory attendance in one week course
Limited number of participants. Registration in ILIAS
The slides and corresponding literature (e.g. ISBN 978-3-662-62822-5 ) can be downloaded in ILIAS
The corresponding workload of the course is 120 hours (= 4 ECTS)
Type of examination: oral test (about 30 minutes)
Course: Digitalization from Production to the Customer in the Optical Industry [T-MACH-110176]

Responsible: Dr.-Ing. Marc Wawerla
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102618 - Major Field: Production Technology

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Events

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Exam

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

Competence Certificate
Alternative test achievement (graded):
- Written processing of a case study (weighting 50%) and
- Presentation of the results (ca. 10 min.) followed by a colloquium (ca. 30 min.), (weighting 50%)

Prerequisites
none

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

Content
The lecture deals with Digitalization along the entire value chain end-to-end, with a focus on production and supply chain. Within this context, concepts, tools, methods, technologies and concrete applications in the industry are presented. Furthermore, the students get the opportunity to get first-hand insights into the digitalization journey of a German technology company.

Main topics of the lecture:
- Concepts and methods such as disruptive innovation and agile project management
- Overview on technologies at disposal
- Practical approaches in innovation
- Applications in industry
- Field trip to ZEISS

Learning Outcomes:
The students …
- are capable to comment on the content covered by the lecture.
- are able to analyze and evaluate the suitability of digitalization technologies in the optical industry.
- are able to assess the applicability of methods such as disruptive innovation and agile project management.
- are able to appreciate the practical challenges to digitalization in industry.

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

Organizational issues
Start: 22.10.2021

Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021
Module Handbook, valid from Winter Term 2021/2022
10.102 Course: Digitalization of Products, Services & Production [T-MACH-108491]

Responsible: Dr.-Ing. Bernd Pätzold
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102613 - Major Field: Lifecycle Engineering

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<th>Grading scale</th>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate
Assessment of another type. Two presentations in team work and two written compositions. Grading: each composition 1/6 and each presentation 2/3.

Prerequisites
none

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

Digitalization of Products, Services & Production
2122310, SS 2021, 2 SWS, Language: German, Open in study portal

Cancelled

Content

- Digitalization of products, services and production in the context of Industry 4.0.
- Key drivers for ongoing digitalization and their impact on future product development and manufacturing.
- Methods and procedures to design the according transformation process.
- Intensive group discussions of use-case scenarios using practical examples from the industry.

Students are able to

- describe the fundamental challenges and objectives of the progressive digitalization of products, service and production. In context of these challenges, students can name and explain the essential terms.
- illustrate the key drivers and fundamental technologies behind the digitalization of products, services and processes.
- describe the challenges of the ongoing digitalization and the corresponding changes in business processes and distinguish between them in regards to time and place. Furthermore, students are able to assign the IT-Architecture and systems to the corresponding process steps.
- highlight the requirement for future information management in networks of product development and production institutions and can clarify how to validated and safeguard the corresponding IT processes.
- to analyze the challenges of digitalization and present potential solution approaches via self-created scenarios for future developments.

Organizational issues
Siehe Homepage zur Lehrveranstaltung

Literature
Vorlesungsskripten / lecture slides

Digitalization of Products, Services & Production
2122310, WS 21/22, 2 SWS, Language: German, Open in study portal
Content

- Digitalization of products, services and production in the context of Industry 4.0.
- Key drivers for ongoing digitalization and their impact on future product development and manufacturing.
- Methods and procedures to design the according transformation process.
- Intensive group discussions of use-case scenarios using practical examples from the industry.

Students are able to

- describe the fundamental challenges and objectives of the progressive digitalization of products, service and production. In context of these challenges, students can name and explain the essential terms.
- illustrate the key drivers and fundamental technologies behind the digitalization of products, services and processes.
- describe the challenges of the ongoing digitalization and the corresponding changes in business processes and distinguish between them in regards to time and place. Furthermore, students are able to assign the IT-Architecture and systems to the corresponding process steps.
- highlight the requirement for future information management in networks of product development and production institutions and can clarify how to validated and safeguard the corresponding IT processes.
- to analyze the challenges of digitalization and present potential solution approaches via self-created scenarios for future developments.

Organizational issues
Siehe Homepage zur Lehrveranstaltung

Literature
Vorlesungsfolien / lecture slides
10.103 Course: Do it! – Service-Learning for prospective mechanical engineers
[T-MACH-106700]

**Responsible:** Prof. Dr.-Ing. Barbara Deml

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102824 - Key Competences

<table>
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<tr>
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**Competence Certificate**
Active and regular participation (compulsory attendance) in all appointments; no marking.

**Prerequisites**
Timely enrollment in ILIAS; limited number of participants.
10.104 Course: Drive Train of Mobile Machines [T-MACH-105307]

Responsible:  Prof. Dr.-Ing. Marcus Geimer
              Marco Wydra
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102599 - Major Field: Powertrain Systems
- M-MACH-102630 - Major Field: Mobile Machines

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

Events

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<td>1 SWS</td>
<td>Practice / 🧩</td>
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Exams

| ST 2021  | Drive Train of Mobile Machines | 76-T-MACH-105307 | Geimer |
| WT 21/22 | Drive Train of Mobile Machines | 76-T-MACH-105307 | Geimer |

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

Competence Certificate

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

Prerequisites

none

Recommendation

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

Annotation

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

Content:

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

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

Media: projector presentation

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

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

Drive Train of Mobile Machines
2113077, WS 21/22, 2 SWS, Language: German, Open in study portal

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

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

Literature
Skriptum zur Vorlesung downloadbar über ILIAS
10 COURSES  
Course: Dynamics of Electro-Mechanical Systems [T-MACH-111260]

10.105 Course: Dynamics of Electro-Mechanical Systems [T-MACH-111260]

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

**Part of:**  
M-MACH-102598 - Major Field: Advanced Mechatronics  
M-MACH-102614 - Major Field: Mechatronics  
M-MACH-102647 - Major Field: Microactuators and Microsensors  
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics  
M-MACH-104443 - Major Field: Vibration Theory

**Type**  
Written examination  
**Credits**  
5  
**Grading scale**  
Grade to a third  
**Expansion**  
1 terms  
**Version**  
1

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**Exams**  
ST 2021 76-T-MACH-111260 Dynamics of Electro-Mechanical Systems  
WT 21/22 76-T-MACH-111260 Dynamics of Electro-Mechanical Systems  

<table>
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<th>Competence Certificate</th>
<th>Written exam, 120 minutes</th>
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</table>

| Prerequisites | None |

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

**Dynamics of electro-mechanical systems**  
2162210, SS 2021, 2 SWS, Language: German, [Open in study portal](#)  
Lecture (V)  
Blended (On-Site/Online)

**Content**  
The lecture conveys two kinds of describing electro-mechanical systems. The first one (described shortly) is based on state and flow variables, the second one (which is in the focus of the course) is based on an energetic description and the Lagrange-Maxwell-Formalism. These methods are then applied in order to analyse the most important electro-mechanical systems. These include:

- Dynamics of electro-mechanical converter and vibration exciters taking into account the load in resonance operation
- Dynamics of electrical machines taking into account the rotordynamic effects (imbalance, loss of stability, passage through resonance)
- Dynamics of piezo-electrical converters in sensor and actor operation
10.106 Course: Dynamics of the Automotive Drive Train [T-MACH-105226]

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102599 - Major Field: Powertrain Systems
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics
- M-MACH-104443 - Major Field: Vibration Theory

**Events**

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<th>Grading scale</th>
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**Exams**

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<td>WT 21/22 2163111</td>
<td>2 SWS</td>
<td>Dynamics of the Automotive Drive Train</td>
<td>Fidlin</td>
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<td>WT 21/22 2163112</td>
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<td>Übungen zu Dynamik des Kfz-Antriebsstrangs</td>
<td>Fidlin, Luo</td>
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**Competence Certificate**

Oral examination, 30 min.

**Prerequisites**

none

**Recommendation**

Powertrain Systems Technology A: Automotive Systems | Machine Dynamics | Vibration Theory

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

**Dynamics of the Automotive Drive Train**

2163111, WS 21/22, 2 SWS, Language: German, Open in study portal

**Exercises**

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

**Literature**

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

**Übungen zu Dynamik des Kfz-Antriebsstrangs**

2163112, WS 21/22, 2 SWS, Language: German, Open in study portal

**Content**

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

### EdgeAI in Software and Sensor Applications

**2400006, SS 2021, 2 SWS, Language: English, Open in study portal**

**Lecture (V) Online**

#### Content

Just imagine a world, where every thing you touch is intelligent and ready to assist you. Where everyday devices learn with you autonomously all the time, augmenting your senses and providing immediate feedback for your decisions. EdgeAI is the next frontier in artificial intelligence that enables such capabilities in the smallest imaginable devices and sensors even when there is no cloud connectivity.

Edge Computing includes applications, data, services at the periphery of networks that are close to real-world sensors. Edge systems are typically constrained in their available energy budget, CPUs, memory, and connectivity. Fog computing further combines these aspects with cloud architectures in order to add enhanced local pre-processing and intelligence that extends the capabilities of classical clouds.

Modern sensor applications - for instance in industrial monitoring and logistics, Internet-of-Things, Ubiquitous Computing, mobile devices, wearables & hearables, health & fitness, drones, or augmented reality - increasingly rely on Edge and Fog Computing to better handle Big Data, always-on applications, continuous fusion of data streams, and new kinds of use cases that were unimaginable before.

In this context, Edge Artificial Intelligence methods (Edge-AI) become key to the realization of continuously learning systems that provide more autonomy and instant feedback. In contrast to mainstream AI, EdgeAI techniques have to cope with significant resource constraints and be fault-tolerant. This course therefore picks up on this exciting topic to provide an overview of state-of-the-art, further dive into current research works, show demonstrations, and discuss open problems.

[Note: Online Video-Streaming and e-Learning will be offered to all registered participants. Details will be communicated to students via the email address provided at the course registration]

#### Organizational issues


#### Literature


Content
Just imagine a world, where every thing you touch is intelligent and ready to assist you. Where everyday devices learn with you autonomously all the time, augmenting your senses and providing immediate feedback for your decisions. EdgeAI is the next frontier in artificial intelligence that enables such capabilities in the smallest imaginable devices and sensors even when there is no cloud connectivity.

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In this context, Edge Artificial Intelligence methods (Edge-AI) become key to the realization of continuously learning systems that provide more autonomy and instant feedback. In contrast to mainstream AI, EdgeAI techniques have to cope with significant resource constraints and be fault-tolerant. This course therefore picks up on this exciting topic to provide an overview of state-of-the-art, further dive into current research works, show demonstrations, and discuss open problems.

[Note: Online Video-Streaming and e-Learning will be offered to all registered participants. Details will be communicated to students via the email address provided at the course registration]

Organizational issues

Literature
**10.108 Course: Electric Rail Vehicles [T-MACH-102121]**

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102641 - Major Field: Rail System Technology

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<td>Electric Rail Vehicles</td>
<td>2</td>
<td>Lecture Online</td>
<td>Tesar, Gratzfeld</td>
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**Exams**

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<td>76-T-MACH-102122</td>
<td>Electric Rail Vehicles</td>
<td>2</td>
<td>Otto, Tesar, Gratzfeld</td>
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<td>2</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

**Oral examination**

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

**Prerequisites**

none

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

**Electric Rail Vehicles**  
2114346, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Content**

1. Introduction: history of electric traction in railways, economic impact  
2. Wheel-rail-contact: carrying of vehicle mass, adhesion, current return  
3. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles  
4. Electric drives: purpose of electric drive and basic configurations, traction motors, converters, drives for vehicles at dc and ac lines and without contact wire, multi-system, dual power and hybrid vehicles, conventional drives for existing vehicles  
5. Train control management system: definitions, bus systems, components, network architectures, examples, future trends  
6. Vehicle concepts: modern vehicle concepts for mass transit and electric main line  
7. Traction power supply: power supply of railway vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire

**Organizational issues**

Die Vorlesung "Elektrische Schienenfahrzeuge" findet im SS 2021 als asynchrone Online-Veranstaltung statt.

**Literature**

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.  
A bibliography is available for download (Ilias-platform).
### Course: Electrical Engineering for Business Engineers, Part II [T-ETIT-100534]

**Responsible:** Dr. Wolfgang Menesklou  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-102739 - Fundamentals and Methods of Automotive Engineering

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#### Exams

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Legend: 🌐 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
10.110 Course: Electrical Machines and Power Electronics [T-ETIT-101954]

**Responsible:** Dr.-Ing. Klaus-Peter Becker

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

**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

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

**Prerequisites**

none
10.111 Course: Elements and Systems of Technical Logistics [T-MACH-102159]

**Responsible:** Georg Fischer  
Dr.-Ing. Martin Mittwollen  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102618 - Major Field: Production Technology  
M-MACH-102640 - Major Field: Technical Logistics  

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

**Competence Certificate**  
The assessment consists of an oral exam (20min) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

**Prerequisites**  
none

**Recommendation**  
Knowledge out of "Basics of Technical Logistics I" (T-MACH-109919) preconditioned.

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

<table>
<thead>
<tr>
<th>Events</th>
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<th>Credits</th>
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<tr>
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<td>Elements and systems of Technical Logistics</td>
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<td>Lecture / Practice (VÜ)</td>
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**Organizational issues**  
Die Vorlesung wird ab SS 2022 in stark überarbeiteter Form angeboten werden.  

Für die bisherige Veranstaltung werden weiterhin Prüfungen zu den üblichen Terminen angeboten.  

Die Erfolgskontrolle erfolgt in Form einer mündlichen (20min.) Prüfung (nach §4 (2), 2 SPO). Die Prüfung wird in jedem Semester angeboten und kann zu jedem ordentlichen Prüfungstermin wiederholt werden.  

siehe auch Homepage / ILIAS

This lecture will be offered in a deeply restructured form in SS 2022  
Assessment for the former lecture is provided also in the future at the regular times  
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 regulations.

look also at our homepage / ILIAS
10 COURSES

Course: Elements and Systems of Technical Logistics - Project [T-MACH-108946]

Responsible: Georg Fischer  
Dr.-Ing. Martin Mittwollen

Organisation: KIT Department of Mechanical Engineering

Part of:  
M-MACH-102618 - Major Field: Production Technology  
M-MACH-102640 - Major Field: Technical Logistics

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Events

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Exams

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

Competence Certificate

Presentation of performed project and defense (30min) according to $4 (2), No. 3 of the examination regulation

Prerequisites

T-MACH-102159 (Elements and Systems of Technical Logistics) must have been started

Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-102159 - Elements and Systems of Technical Logistics must have been started.

Recommendation

Knowledge out of "Basics of Technical Logistics I" (T-MACH-109919) preconditioned.

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

Elements and systems of Technical Logistics - project
2117097, WS 21/22, SWS, Language: German, Open in study portal  

Project (PRO)  
Cancelled

Organizational issues

Das Projekt (als Ergänzung zur Vorlesung) wird ab SS 2022 in stark überarbeiteter Form angeboten werden.  
Für die bisherige Veranstaltung werden weiterhin Prüfungen zu den üblichen Terminen angeboten.  
Die Erfolgskontrolle erfolgt in Form einer mündlichen (20min.) Prüfung (nach §4 (2), 2 SPO). Die Prüfung wird in jedem Semester angeboten und kann zu jedem ordentlichen Prüfungstermin wiederholt werden.

siehe auch Homepage / ILIAS

This project (as complement to the lecture) will be offered in a deeply restructured form in SS 2022  
Assessment for the former lecture is provided also in the future at the regular times  
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 regulations.

look also at our homepage / ILIAS
10.113 Course: Energy and Indoor Climate Concepts [T-ARCH-107406]

Responsible: Prof. Andreas Wagner
Organisation: KIT Department of Architecture
Part of: M-MACH-102648 - Major Field: Energy Technology for Buildings

<table>
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Events

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

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

Energy and Indoor Climate Concepts
1720970, SS 2021, 2 SWS, Language: German, Open in study portal

Content
The students will become familiar with concepts and technologies of energy-efficient building. Topics like heat protection, passive solar energy use, ventilation systems and passive cooling are addressed. New ways of renewable energy supply show the path towards climate-neutral buildings. On the basis of examples from practice, energy and indoor climate concepts for different buildings types are investigated in detail and analyzed with regard to presented performance criteria. For qualification targets see module handbook.

Appointment: Tues. 10:00 AM - 11:30 AM
First meeting: Tues. 13.04.2021, 10:00 AM
Submission/Exam: 03.08.2021
Number of Participants: 10
## Course: Energy demand of buildings – fundamentals and applications, with building simulation exercises [T-MACH-105715]

### Responsible:
Dr. Ferdinand Schmidt

### Organisation:
KIT Department of Mechanical Engineering

### Part of:
M-MACH-102648 - Major Field: Energy Technology for Buildings

### Events

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### Exams

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| ST 2021| 2158203 | Energy demand of buildings – fundamentals and applications, with building simulation exercises | 4 SWS   | Schmidt
| ST 2021| 76-T-MACH-105715 | Energy demand of buildings – fundamentals and applications, with building simulation exercises | Schmidt |
| WT 21/22 | 76-T-MACH-105715 | Energy demand of buildings – fundamentals and applications, with building simulation exercises | Schmidt |

### Competence Certificate

oral exam, approx. 30 minutes

### Prerequisites

none

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

<table>
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<th>Events</th>
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<td>Energy demand of buildings – fundamentals and applications, with building simulation exercises</td>
<td>Lecture / Practice (VÜ) On-Site</td>
<td>2158203, SS 2021, 4 SWS, Language: German, Open in study portal</td>
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</table>
Course: Energy demand of buildings – fundamentals and applications, with building simulation exercises [T-MACH-105715]

Content

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

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

Exam conditions:

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

Literature

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

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

**Organisation:**  KIT Department of Mechanical Engineering

**Part of:**  M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102618 - Major Field: Production Technology
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102629 - Major Field: Logistics and Material Flow Theory
M-MACH-102630 - Major Field: Mobile Machines
M-MACH-102640 - Major Field: Technical Logistics

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**Events**

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<td>Lecture / 🗣</td>
<td>2 SWS</td>
<td>Grade to a third</td>
<td>Each winter term</td>
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</table>

**Competence Certificate**

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

**Prerequisites**

none

**Recommendation**

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

**Annotation**

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

---

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

**Energy efficient intralogistic systems**

2117500, WS 21/22, 2 SWS, Language: German, Open in study portal

**Content**

The content of course "Basics of Technical Logistics" should be known.

**Organizational issues**

Termine und Hinweise siehe Homepage / Aushang

**Literature**

Keine.

**Responsible:** Prof. Dr. Christof Weinhardt

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

**Part of:** M-MACH-104323 - Major Field: Innovation and Entrepreneurship

<table>
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**Exams**

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**Competence Certificate**

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

**Prerequisites**

None

**Recommendation**

None

**Annotation**

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

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

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

**Literature**


Responsible: apl. Prof. Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology
- M-MACH-102643 - Major Field: Fusion Technology
- M-MACH-102648 - Major Field: Energy Technology for Buildings

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Exams

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<td>WT 21/22</td>
<td>3 SWS</td>
<td>Lecture / 🗣</td>
<td>Dagan</td>
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</table>

Competence Certificate
oral exam, approx. 1/2 hour

Prerequisites
none

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

Energy Systems I - Renewable Energy
2129901, WS 21/22, 3 SWS, Language: German, Open in study portal

Content
The course deals with fundamental aspects of renewable energies.

1. The first part deals with the basic concepts of absorbing solar beams, in an efficient manner accounting for the minimization of heat losses. In this context, selective topics on thermodynamics as well as fluid dynamics are introduced. In the second part few applications are discussed and optimizations techniques of solar collectors construction and their heat transfer are presented.
2. The use of solar energy as a source for heat generation is followed by the idea of electricity generation. Introductive aspects of Photovoltaic technologies are illuminated.
3. The last part presents additional regenerative energy sources such as wind and geothermal energy.

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

regular attendance: 34 hours
self-study: 146 hours

Oral examination – as an elective course 30 minutes, in combination with Energiesysteme-II or other courses within the energy courses, as a major course 1 hour

Organizational issues
Die Veranstaltung wird nur online gehalten, falls durch Corona Einschränkungen vorgegeben werden.
10.118 Course: Energy systems II: Reactor Physics [T-MACH-105550]

**Responsible:** Dr. Aurelian Florin Badea  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102608 - Major Field: Nuclear Energy

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**Exams**

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**Competence Certificate**

oral exam, 20 min

**Prerequisites**

none

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

**Energy systems II: Reactor Physics**

2130929, SS 2021, 2 SWS, Language: German, Open in study portal

**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**

Mo (26.07.2021), 09:00 bis 17:00
Di (27.07.2021), 09:00 bis 17:00
Mi (28.07.2021), 09:00 bis 17:00
Literature
Dieter Schmidt, Reaktortechnik, Band 1: Grundlagen, ISBN 3 7650 2003 6
10.119 Course: Engine Laboratory [T-MACH-105337]

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

**Part of:**  
- M-MACH-102591 - Laboratory Course  
- M-MACH-102627 - Major Field: Energy Converting Engines  
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains  
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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<th>Engine Laboratory</th>
<th>2 SWS</th>
<th>Practical course /</th>
<th>Wagner</th>
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</table>

**Exams**

| ST 2021 | 76-T-MACH-105337 | Engine Laboratory | | Koch |

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

**Competence Certificate**

written documentation of every experiment, certificate of successful attendance, no grading

**Prerequisites**

none

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

**Engine Laboratory**  
2134001, SS 2021, 2 SWS, Language: German, Open in study portal  
Practical course (P)  
On-Site

**Organizational issues**

voraussichtlich 1. vorlesungsfreie Woche im SS 2021. Wird auf der Homepage und in den Vorlesungen bekannt gegeben

**Literature**

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

**Responsible:** Dr.-Ing. Sören Bernhardt  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102607 - Major Field: Vehicle Technology  
M-MACH-102624 - Major Field: Information Technology  
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains  
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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**Exams**

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

**Competence Certificate**

oral examination, Duration: 0.5 hours, no auxiliary means

**Prerequisites**

none

**Recommendation**

T-MACH-102194 Combustion Engines I

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

**Engine measurement techniques**

2134137, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**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-Meißtechnik, Band C
10 COURSES

Course: Engineer's Field of Work [T-MACH-105721]

10.121 Course: Engineer's Field of Work [T-MACH-105721]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102824 - Key Competences

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Exams

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 📧 On-Site, ⏪ Cancelled

Competence Certificate
written test
Duration: 60 minutes
result: passed / not passed
No tools or reference materials may be used during the exam.

Prerequisites
none

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

Lecture (V)
Engineer's Field of Work
2114917, SS 2021, 2 SWS, Language: German, Open in study portal

Online
Content

AFI1: Organization of Companies (Peter Gratzfeld, 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

AFI2: Project Management (Peter Gratzfeld, Marcus Geimer)
definition of project, project manager, project team, primary processes, supporting processes

AFI3: Personnel Development (Martin Doppelbauer)
aplications, 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 (Peter Gratzfeld, 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 (Peter Gratzfeld, 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 (Peter Gratzfeld, Marcus Geimer)
principles of governance (accountability, responsibility, transparency, fairness), leadership (technical, commercial), reviews, boards, audits, codetermination, compliance

Organizational issues

Die Vorlesung "Das Arbeitsfeld des Ingenieurs" findet im SS 2021 als asynchrone Online-Veranstaltung statt.
Course: Entrepreneurship [T-WIWI-102864]

10.122 Course: Entrepreneurship [T-WIWI-102864]

Responsible: Prof. Dr. Orestis Terzidis
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104323 - Major Field: Innovation and Entrepreneurship

<table>
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Exams

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

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

Students are offered the opportunity to earn a grade bonus through separate assignments. If the grade of the written exam is between 4.0 and 1.3, the bonus improves the grade by a maximum of one grade level (0.3 or 0.4). The exact criteria for awarding a bonus will be announced at the beginning of the lecture.

Prerequisites
None

Recommendation
None

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

Entrepreneurship

2545001, SS 2021, 2 SWS, Language: English, Open in study portal

Literature

Füglistaller, Urs, Müller, Christoph und Volery, Thierry (2008): Entrepreneurship
Ries, Eric (2011): The Lean Startup
10.123 Course: Exercises - Fatigue of Welded Components and Structures [T-MACH-109304]

**Responsible:** Dr. Majid Farajian

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102602 - Major Field: Reliability in Mechanical Engineering

<table>
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**Competence Certificate**
Successful solving of all exercises

**Prerequisites**
None

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

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

**Preliminary knowledge**
Materials science and mechanics recommended

**Regular attendance**
22.5 hours

**Self-study**
97.5 hours

**Exercise sheets**
Handed out regularly.

**Oral examination**
(20 min)

**Tools or reference materials**
No tools or reference materials

**Organizational issues**
Blockveranstaltung. Zur Teilnahme an der Vorlesung ist eine Anmeldung beim Dozenten per E-Mail an Farajian@slv-duisburg.de erforderlich. Vorlesungstermine und Hörsaal werden den angemeldeten Teilnehmern mitgeteilt.

**Literature**
2. FKM-Richtlinie, Bruchmechanischer Festigkeitsnachweis, Forschungskuratorium Maschinenbau, VDMA Verlag, 2009
# 10.124 Course: Exercises - Tribology [T-MACH-109303]

**Responsible:** Prof. Dr. Martin Dienwiebel  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:**  
- M-MACH-102599 - Major Field: Powertrain Systems  
- M-MACH-102637 - Major Field: Tribology  
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

<table>
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**Events**

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

**Competence Certificate**  
successful solving of all exercises

**Prerequisites**  
none

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

**Tribology**  
2181114, WS 21/22, 5 SWS, Language: German, [Open in study portal](#)

**Lecture / Practice (VÜ)**  
[Online](#)
Content

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

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

The student can

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

preliminary knowledge in mathematics, mechanics and materials science recommended
regular attendance: 45 hours
self-study: 195 hours
oral examination (ca. 40 min)
no tools or reference materials
admission to the exam only with successful completion of the exercises

Literature

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

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

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  

**Type**  
Completed coursework  

**Credits**  
2  

**Grading scale**  
Pass/fail  

**Recurrence**  
Each summer term  

**Version**  
3  

### Events

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**Exams**

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

### Competence Certificate

successful solving of all exercises

### Prerequisites

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

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-110928 - Exercises for Applied Materials Simulation must not have been started.

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

#### Applied Materials Simulation

2182614, SS 2021, 4 SWS, Language: German, Open in study portal  

**Lecture / Practice (VÜ)**  
Online

### Content

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

The student can

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

**preliminary knowledge in mathematics, physics and materials science recommended**

**regular attendance:** 34 hours  
**exercise:** 11 hours  
**self-study:** 165 hours  
**oral exam ca. 35 minutes**  
**no tools or reference materials**  
**admission to the exam only with successful completion of the exercises**
Organizational issues

Die Vorlesung wir nur als Aufzeichnung angeboten!

Bitte besuchen Sie die englischsprachige Veranstaltung "Applied Materials Simulation" (21 82 616)!

Weitere Informationen finden Sie in ILIAS.

Kontakt: johannes.schneider@kit.edu

Literature

10 COURSES

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

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

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

Events

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Exams

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

Competence Certificate

successful solving of all exercises

Prerequisites

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

Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-107671 - Exercises for Applied Materials Simulation must not have been started.

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

Applied Materials Simulation

2182616, SS 2021, 4 SWS, Language: English, Open in study portal

Content

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

The student can

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

preliminary knowledge in mathematics, physics and materials science recommended

regular attendance: 34 hours
exercise: 11 hours
self-study: 165 hours
oral exam ca. 35 minutes
no tools or reference materials
admission to the exam only with successful completion of the exercises

Organizational Issues

The lecture is made available weekly as a link.
Further information can be found in ILIAS.
Contact: johannes.schneider@kit.edu

Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021
Module Handbook, valid from Winter Term 2021/2022
Literature

10 COURSES

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

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

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<th>Each winter term</th>
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Events

WT 21/22 2193005 Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria 1 SWS Practice / Seifert, Ziebert

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

Competence Certificate
successful solving of all exercises

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

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

V Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria
2193005, WS 21/22, 1 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

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

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

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

regular attendance: 14 hours
self-study: 46 hours

Organizational issues
Die genauen Termine werden in der Vorlesung bekannt gegeben.

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

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102611 - Major Field: Materials Science and Engineering

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**Completed coursework**

**Credits**

2

**Grading scale**

pass/fail

**Recurrence**

Each summer term

**Version**

4

**Events**

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

**Competence Certificate**

Regular attendance

**Prerequisites**

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

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

**Materials Characterization**

2174586, SS 2021, 2 SWS, Language: German, [Open in study portal]

**Content**

The following methods will be introduced within this lecture:

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

**learning objectives:**

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

**Organizational issues**


The lecture will be online (asynchronous). The lecture notes, supplementary material and the recording of lecture slides with audio track will be managed via ILIAS. The registration will be possible without restriction until 30.04.2021. Subsequently, registration is only possible by direct contacting Dr.-Ing. Jens Gibmeier. In summer term 2021 the lecture will be in German. The English course will be offered in winter term 2021 (starting in October 2021)

**Literature**

Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben). Literatur wird zu Beginn der Veranstaltung bekanntgegeben.
10.COURSES
Course: Exercises for Solid State Reactions and Kinetics of Phase Transformations [T-MACH-107632]

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

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering

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<th>Each winter term</th>
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Events

 uw 21\(\text{/}22\) 2193004 Exercises for Solid State Reactions and Kinetics of Phase Transformations 1 SWS Practice / 🧩 Franke, Ziebert

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗓 On-Site, ⏳ Cancelled

Competence Certificate
successful processing of exercises

Prerequisites
T-MACH-110926 – Exercises for Solid State Reactions and Kinetics of Phase Transformations has not been started

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

V Exercises for Solid State Reactions and Kinetics of Phase Transformations
2193004, WS 21\(\text{/}22\), 1 SWS, Language: German, Open in study portal

Practice (Ü) Blended (On-Site/Online)

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

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

Reinforcement of the lecture by the solution of practical and lecture-relevant exercises
regular attendance: 14 hours
self-study: 46 hours

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

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

**Part of:**  
M-MACH-102598 - Major Field: Advanced Mechatronics  
M-MACH-102614 - Major Field: Mechatronics  
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics  
M-MACH-104443 - Major Field: Vibration Theory

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**Events**

| ST 2021 | 2162225 | Experimental Dynamics | 3 SWS | Lecture / 🧩 | Fidlin |
| ST 2021 | 2162228 | Übungen zu Experimentelle Dynamik | 2 SWS | Practice / 🖥 | Fidlin, Bitner |

**Exams**

| ST 2021 | 76-T-MACH-105514 | Experimental Dynamics | Fidlin |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗡 On-Site, ⚡ Cancelled

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

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

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

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

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

**Experimental Dynamics**  
2162225, SS 2021, 3 SWS, Language: German, Open in study portal

**Content**

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

**Responsible:** Dr. Jochen Kriegseis  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102627 - Major Field: Energy Converting Engines  
- M-MACH-102634 - Major Field: Fluid Mechanic  
- M-MACH-102636 - Major Field: Thermal Turbomachines

**Type**  
Oral examination

**Credits**  
4

**Grading scale**  
Grade to a third

**Recurrence**  
Each summer term

**Version**  
1

**Events**

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**Exams**

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

**Competence Certificate**  
oral exam - 30 minutes

**Prerequisites**  
none

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

**Experimental Fluid Mechanics**

2154446, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**

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

The lecture covers a selection of the following topics:

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

**Organizational issues**

Die Vergabe von Leistungspunkten zu den Veranstaltungen mit LVNr 2154446 und 2153530 schließt sich gegenseitig aus.

**Literature**


**Experimental Fluid Mechanics**

2153530, WS 21/22, 2 SWS, Language: English, Open in study portal

**Lecture (V)**

Online

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 measurement signal and data obtained with the common fluid mechanical measuring techniques.

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

The lecture covers a selection of the following topics:

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

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

**Responsible:** Dr.-Ing. Stefan Dietrich

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102618 - Major Field: Production Technology

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

| WT 21/22 | 2173560 | Welding Lab Course, in groupes | 3 SWS | Practical course / Dietrich, Schulze |

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

**Competence Certificate**

Certificate to be issued after evaluation of the lab class report.

**Prerequisites**

Certificate of attendance for Welding technique (The participation in the course Welding Technology I/II is assumed.).

**Annotation**

The lab takes place at the beginning of the winter semester break once a year. The registration is possible during the lecture period in the secretariat of the Institute of Applied Materials (IAM – WK). The lab is carried out in the Handwerkskammer Karlsruhe.

You need sturdy shoes and long clothes!

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

**Welding Lab Course, in groupes**

2173560, WS 21/22, 3 SWS, Language: German, [Open in study portal]

**Practical course (P)**

On-Site

**Content**

The lab takes place at the beginning of the winter semester break once a year. The registration is possible during the lecture period in the secretariat of the Institute of Applied Materials (IAM – WK). The lab is carried out in the Handwerkskammer Karlsruhe.

**learning objectives:** The students are capable to name a survey of current welding processes and their suitability for joining different metals. The students can evaluate the advantages and disadvantages of the individual procedures. The students have weld with different welding processes.

**requirements:**

Certificate to be issued after evaluation of the lab class report

You need sturdy shoes and long clothes!

**workload:**

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

**Organizational issues**

Praktikum findet nur statt, wenn es die Pandemie-Situation zulässt.

**Literature**

wird im Praktikum ausgegeben
10.133 Course: Experimental techniques in thermo- and fluid-dynamics [T-MACH-106373]

Responsible: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102635 - Major Field: Engineering Thermodynamics

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Events

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<td>Experimental Techniques in thermo- and fluid-dynamics</td>
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Exams

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<tr>
<td>ST 2021</td>
<td>76-T-MACH-106373</td>
<td>Experimental techniques in thermo- and fluid-dynamics</td>
<td>Cheng</td>
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</table>

Competence Certificate

oral exam, duration 20 min

Prerequisites

none
# 10.134 Course: Fabrication Processes in Microsystem Technology [T-MACH-102166]

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

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102616 - Major Field: Microsystem Technology  
M-MACH-102647 - Major Field: Microactuators and Microsensors

<table>
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**Competence Certificate**  
Oral examination, 20 minutes

**Prerequisites**  
none

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

### Fabrication Processes in Microsystem Technology  
2143882, SS 2021, 2 SWS, Language: German, [Open in study portal](#)  

**Lecture (V) Online**

**Content**  
The lecture offers an advanced understanding of manufacturing processes in microsystem technology. Basic aspects of microtechnological processing will be introduced. With examples from semiconductor microfabrication and microsystem technology the base processing steps for conditioning and finishing, patterning, removal are imparted. Nano-patterning is covered is also included and the micro-nano interface is discussed. By the help of typical processing steps elementary mechanisms, process execution, and equipment are explained. Additionally quality control, process control and environmental topics are included.

**Literature**  
M. Madou  
Fundamentals of Microfabrication  
CRC Press, Boca Raton, 1997

W. Menz, J. Mohr, O. Paul  
Mikrosystemtechnik für Ingenieure  
Dritte Auflage, Wiley-VCH, Weinheim 2005

L.F. Thompson, C.G. Willson, A.J. Bowden  
Introduction to Microlithography  

### Fabrication Processes in Microsystem Technology  
2143882, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)  

**Lecture (V) Blended (On-Site/Online)**
Literature
M. Madou
Fundamentals of Microfabrication
CRC Press, Boca Raton, 1997
W. Menz, J. Mohr, O. Paul
Mikrosystemtechnik für Ingenieure
Dritte Auflage, Wiley-VCH, Weinheim 2005
L.F. Thompson, C.G. Willson, A.J. Bowden
Introduction to Microlithography
10.135 Course: Failure Analysis [T-MACH-105724]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering  
M-MACH-102611 - Major Field: Materials Science and Engineering  
M-MACH-102637 - Major Field: Tribology

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**Events**

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<td>Greiner, Schneider</td>
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**Exams**

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

**Competence Certificate**

oral examination, ca. 30 min

**Prerequisites**

none

**Recommendation**

basic knowledge in materials science (e.g. lecture materials science I and II)

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

**Failure Analysis**

2182572, WS 21/22, 2 SWS, Open in study portal

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

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102599 - Major Field: Powertrain Systems  
- M-MACH-102602 - Major Field: Reliability in Mechanical Engineering  
- M-MACH-102611 - Major Field: Materials Science and Engineering  
- M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials  
- M-MACH-102628 - Major Field: Lightweight Construction  
- M-MACH-102636 - Major Field: Lightweight Construction

**Type**  
Oral examination

**Credits**  
4

**Grading scale**  
Grade to a third

**Recurrence**  
Each winter term

**Version**  
1

### Events

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<td>2181711</td>
<td>Failure of structural materials: deformation and fracture</td>
<td>Lecture / Practice (L/P)</td>
<td>3 SWS</td>
<td>Grade to a third</td>
<td>Each winter term</td>
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**Exams**

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<td>Failure of Structural Materials: Deformation and Fracture</td>
<td>Lecture / Practice (L/P)</td>
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<td>Weygand, Gumbsch</td>
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<td>3 SWS</td>
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<td>Weygand, Gumbsch, Kraft</td>
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</table>

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

**Competence Certificate**

oral exam ca. 30 minutes  
no tools or reference materials

**Prerequisites**

none

**Recommendation**

preliminary knowledge in mathematics, mechanics and materials science

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

**Failure of structural materials: deformation and fracture**

2181711, WS 21/22, 3 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**

On-Site
Content

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

The student

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

preliminary knowledge in mathematics, mechanics and materials science recommended

regular attendance: 22,5 hours
self-study: 97,5 hours

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

Organizational issues

Übungstermine werden in der Vorlesung bekannt gegeben!
nach aktuellem Stand Präsenz

Literature

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

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

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102602 - Major Field: Reliability in Mechanical Engineering  
- M-MACH-102611 - Major Field: Materials Science and Engineering  
- M-MACH-102628 - Major Field: Lightweight Construction  
- M-MACH-102636 - Major Field: Thermal Turbomachines

**Type**  
- Oral examination  

**Credits**  
- 4

**Grading scale**  
- Grade to a third

**Recurrence**  
- Each winter term

**Version**  
- 1

### Events

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<td>Each winter term</td>
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### Courses

**WT 21/22**  
- 2181715  
- Failure of Structural Materials: Fatigue and Creep  
- 2 SWS  
- Lecture / Blended (On-Site/Online)  
- Gruber, Gumbsch

### Exams

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<tr>
<th>Exams</th>
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<td>2 SWS</td>
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<td>Each winter term</td>
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<td>Failure of Structural Materials: Fatigue and Creep</td>
<td>2 SWS</td>
<td>Lecture / Blended (On-Site/Online)</td>
<td>Grade to a third</td>
<td>Each winter term</td>
<td>Kraft, Gumbsch, Gruber</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

### Competence Certificate

- Oral exam ca. 30 minutes  
- No tools or reference materials

### Prerequisites

None

### Recommendation

- Preliminary knowledge in mathematics, mechanics, and materials science

Below you will find excerpts from events related to this course:
Content
1 Fatigue
1.1 Introduction
1.2 Lifetime
1.3 Fatigue Mechanisms
1.4 Material Selection
1.5 Notches and Shape Optimization
1.6 Case Studies: ICE-Accidents

2 Creep
2.1 Introduction
2.2 High Temperature Plasticity
2.3 Phänomenological Description of Creep
2.4 Creep Mechanisms
2.5 Alloying Effects

The student
• has the basic understanding of mechanical processes to explain the relationships between externally applied load and materials strength.
• can describe the main empirical materials models for fatigue and creep and can apply them.
• has the physical understanding to describe and explain phenomena of failure.
• can use statistical approaches for reliability predictions.
• can use its acquired skills, to select and develop materials for specific applications.

preliminary knowledge in mathematics, mechanics and materials science recommended
regular attendance: 22.5 hours
self-study: 97.5 hours

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

Literature
• Bruchvorgänge in metallischen Werkstoffen, D. Aurich (Werkstofftechnische Verlagsgesellschaft Karlsruhe), relativ einfach aber dennoch umfassender Überblick für metallische Werkstoffe
• Fatigue of Materials, Subra Suresh (2nd Edition, Cambridge University Press); Standardwerk über Ermüdung, alle Materialklassen, umfangreich, für Einsteiger und Fortgeschrittene
# 10.138 Course: Fatigue of Metallic Materials [T-MACH-105354]

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

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102602 - Major Field: Reliability in Mechanical Engineering  
- M-MACH-102610 - Major Field: Power Plant Technology  
- M-MACH-102611 - Major Field: Materials Science and Engineering  
- M-MACH-102636 - Major Field: Thermal Turbomachines

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**Events**

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<td>Fatigue of Metallic Materials</td>
<td>Lecture</td>
<td>Guth</td>
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<td>Fatigue of Metallic Materials</td>
<td>Lecture</td>
<td>Guth</td>
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**Competence Certificate**  
Oral exam, about 20 minutes

**Prerequisites**  
none

**Recommendation**  
Basic knowledge in Materials Science will be helpful.

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

**Fatigue of Metallic Materials**  
2173585, WS 21/22, 2 SWS, Language: German, Open in study portal  
Lecture (V)  
Blended (On-Site/Online)

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

**Learning objectives:**  
The students are able to recognise the deformation and the failure behaviour of metallic materials under cyclic loading and to assign it to the basic microstructural processes. They know the sequence and the development of fatigue damages and can evaluate the initiation and the growth of fatigue cracks.  
The students can assess the cyclic strength behaviour of metallic materials and components both qualitatively and quantitatively and know the procedures for the assessment of single-stage, multistage and stochastic cyclical loadings. Furthermore, they can take into account the influence of residual stresses.

**Requirements:**  
none, basic knowledge in Material Science will be helpful

**Workload:**  
regular attendance: 21 hours  
self-study: 99 hours
Literature
Ein Manuskript, das auch aktuelle Literaturhinweise enthält, wird in der Vorlesung verteilt.
**10.139 Course: Fatigue of Welded Components and Structures [T-MACH-105984]**

**Responsible:** Dr. Majid Farajian  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering  
M-MACH-102611 - Major Field: Materials Science and Engineering

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**Events**

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**Competence Certificate**

oral examination (ca. 30 min)  
no tools or reference materials

**Prerequisites**

admission to the exam only with successful completion of the exercises [T-MACH-109304]

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-109304 - Excercises - Fatigue of Welded Components and Structures must have been passed.

**Recommendation**

preliminary knowledge materials science and mechanics

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

**Fatigue of Welded Components and Structures**

2181731, WS 21/22, 2 SWS, Language: German, [Open in study portal]

**Content**

The lecture gives an introduction to the following topics:

- weld quality  
- typical damages of welded joints  
- evaluation of notches, defects and residual stresses  
- strength concepts: nominal, structural and notch stress concepts, fracture mechanics  
- life cycle analysis  
- post-treatment methods for an extended lifetime  
- maintenance, reconditioning and repair

The student can

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

preliminary knowledge materials science and mechanics recommended

regular attendance: 22.5 hours  
self-study: 97.5 hours  
Exercise sheets are handed out regularly.  
oral examination (ca. 30 min)  
no tools or reference materials
Organizational issues
Blockveranstaltung. Zur Teilnahme an der Vorlesung ist eine Anmeldung beim Dozenten per E-Mail an Farajian@slv-duisburg.de erforderlich. Vorlesungstermine und Hörsaal werden den angemeldeten Teilnehmern mitgeteilt.

Literature
2. FKM-Richtlinie, Bruchmechanischer Festigkeitsnachweis, Forschungskuratorium Maschinenbau, VDMA Verlag, 2009
10.140 Course: FEM Workshop - Constitutive Laws [T-MACH-105392]

---

**Responsible:** Dr. Katrin Schulz  
Dr. Daniel Weygand  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering  
M-MACH-102604 - Major Field: Computational Mechanics

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**Events**

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<td>Each term</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, ❌ Cancelled

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**Competence Certificate**

- solving of a FEM problem
- preparation of a report
- preparation of a short presentation

---

**Prerequisites**  
none

---

**Recommendation**

Engineering Mechanics; Advanced Mathematics; Introduction to Theory of Materials

---

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

---

**Content**

The course repeats the fundamentals of the theory of materials. It leads to the characterization and classification of material behavior as well as the specification by adequate material models. Here we focus on elastic, viscoelastic, plastic, and viscoplastic deformation behavior. Introducing the finite element program ABAQUS, the students learn how to analyze the material models numerically. Therefore ABAQUS-own and continuative constitutive equations are chosen.

The student

- has the basic understanding of the materials theory and the classification of materials  
- is able to independently generate numerical models using ABAQUS and can choose and apply adequate constitutive equations

Engineering Mechanics; Advanced Mathematics; Introduction to Theory of Materials recommended

regular attendance: 28 hours  
self-study: 92 hours  

Oral examination (ca. 20 min) in the elective module MSc, otherwise no grading

solving of a FEM problem  
preparation of a report  
preparation of a short presentation

---

**Organizational issues**

Blockveranstaltung, Termine werden noch bekannt gegeben!

Kontakt: daniel.weygand@kit.edu

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Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021  
Module Handbook, valid from Winter Term 2021/2022

 Responsible: Prof. Dr. Claus Günther
 Organisation: KIT Department of Mechanical Engineering

 Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
 M-MACH-102604 - Major Field: Computational Mechanics

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<td>Each winter term</td>
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**Type:** Oral examination

**Credits:** 4

**Grading scale:** Grade to a third

**Recurrence:** Each winter term

**Version:** 1

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

**Competence Certificate**
oral exam, Duration: 30 minutes
no auxiliary means

**Prerequisites**
none

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

**Finite Difference Methods for numerical solution of thermal and fluid dynamical problems**
2153405, WS 21/22, 2 SWS, Language: German, Open in study portal

**Content**
The students can apply the most important difference schemes for the numerical solution of steady and transient problems which are typical for thermal and fluid flow problems. They are able to discuss the most relevant properties of difference schemes such as consistency, stability and convergence. Furthermore, they can estimate the order of the numerical error and non-appearance of numerical oscillations.

The students get a basic knowledge of relevant numerical algorithms and the use of them in commercial and open fluid flow codes.

The lecture initially presents an overview and then the most important difference schemes for the numerical solution of steady and transient problems which are typical for thermal and fluid flow problems. The most relevant properties of difference schemes at one side as consistency, stability and convergence, at the other side the order of the numerical error and non-appearance of numerical oscillations are described. Algorithms for the solution of coupled systems of equations, characteristic for fluid flow and thermal problems, are reviewed.

- Spatial and temporal discretization
- Properties of difference schemes
- Numerical stability, consistency, convergence
- Nonhomogeneous meshes
- Coupled and noninteracting calculation methods

**Organizational issues**
Diese Vorlesung wird als Blockvorlesung vom 14. - 18.02.2022 angeboten. Vorherige Anmeldung an claus.günther@kit.edu und heide.hofmann@kit.edu

**Literature**
Folienkopien
10.142 Course: Finite Element Workshop [T-MACH-105417]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102602 - Major Field: Reliability in Mechanical Engineering

<table>
<thead>
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<th>Credits</th>
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<th>pass/fail</th>
<th>Recurrence</th>
<th>Each summer term</th>
<th>Version</th>
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**Events**

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<tr>
<th>Event Code</th>
<th>Code</th>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Instructor(s)</th>
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<tbody>
<tr>
<td>ST 2021</td>
<td>2182731</td>
<td>Finite Element Workshop</td>
<td>2 SWS</td>
<td>Block / x</td>
<td>Weygand, Mattheck, Tesari</td>
<td></td>
</tr>
</tbody>
</table>

Legend: 📱 Online, 🍻 Blended (On-Site/Online), 🗓 On-Site, 🗑 Cancelled

**Competence Certificate**
attendance certificate for participation in all course dates

**Prerequisites**
none

**Recommendation**
Continuum Mechanics

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

**Finite Element Workshop**

<table>
<thead>
<tr>
<th>Event Code</th>
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<tbody>
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<td>Block / x</td>
<td>Weygand, Mattheck, Tesari</td>
<td></td>
</tr>
</tbody>
</table>

**Block (B) Cancelled**

**Content**
The students will learn the foundations of the FEM stress analysis and the optimization method 'Zugdreiecke'.
The student can

- perform stress analysis for simple components using the commercial software package ANSYS
- utilise the method of the tensile triangle to optimize the shape of components with respect to stress distribution

Fundamentals of Continuum Mechanics are required.
regular attendance: 22.5 hours
certificate in case of regular attendance

**Organizational issues**
Der Workshop kann im Sommersemester 2021 leider nicht angeboten werden!

**Responsible:** Prof. Dr. Claus Günther  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102604 - Major Field: Computational Mechanics

<table>
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**Events**

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<th>ST 2021</th>
<th>2154431</th>
<th>Finite Volume Methods for Fluid Flow</th>
<th>2 SWS</th>
<th>Lecture / 🗣 Günther</th>
</tr>
</thead>
</table>

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

**Competence Certificate**
oral exam, Duration: 30 minutes  
no auxiliary means

**Prerequisites**
none

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

**Finite Volume Methods for Fluid Flow**  
2154431, SS 2021, 2 SWS, Language: German, Open in study portal

**Lecture (V)**  
On-Site

**Content**

Students can describe all fundamental aspects of the finite volume methods, which form the basis for a number of different commercial CFD codes. Students become familiar with the basics of the generation of unstructured meshes.

The Finite Volume Method (=FVM) is nowadays of great interest, as it guarantees conservation of all relevant variables and as it can be used on nearly arbitrary meshes. By this it is a fundamental tool for numerical simulation of flows, which plays an ever growing role for construction and engineering and is the basis of several commercial or research codes as CFX, STAR-CCM+, FLUENT or OpenFOAM. The lecture is concerned with all aspects of FVM, mesh generation is also included. Newer developments as CVFEM (control volume based FEM) are described.

- Introduction  
- Conservative schemes  
- Finite volume method  
- Analysis of FVM  
- CVFEM as conservative FEM  
- FVM for Navier-Stokes Equations  
- Basics of mesh generation

**Organizational issues**

Die Lehrveranstaltung wird wegen geringer Teilnehmerzahl abgesagt!!!
10.144 Course: Flow Measurement Techniques [T-MACH-108796]

Responsible: Dr. Jochen Kriegseis
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102591 - Laboratory Course

<table>
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Events

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<td>Flow Measurement Techniques</td>
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Exams

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<td>Flow Measurement Techniques</td>
<td>2</td>
<td>Practical course / Online</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Participation in at least 7 out of 9 events, successful initial colloquium prior to the respective measurements and submission of a significant report after every experiment

Prerequisites
none

Recommendation
The content of lecture "Experimental Fluid Mechanics" (T-MACH-105512)

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

Flow Measurement Techniques
2155425, SS 2021, 2 SWS, Open in study portal

Practical course (P)
Online

Content
The following flow measurement techniques are considered:
- wind tunnel techniques and estimation of turbulence intensity
- hot wire calibration an measurement
- 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:
Teilnahme an mindestens 7 der 9 Termine, erfolgreiche Eingangskolloquien vor jedem Versuch und Abgabe eines aussagekräftigen Versuchsprotokolls nach jedem Experiment

Participation in at least 7 out of 9 events, successful initial colloquium prior to the respective measurements and submission of a significant report after every experiment

Empfehlungen:
Kenntnisse der Vorlesung "Experimentelle Strömungsmechanik" (LVNr. 2154446)
The content of lecture "Experimental Fluid Mechanics" (LVNr. 2154446)

Flow Measurement Techniques
2155425, WS 21/22, 2 SWS, Language: German, Open in study portal

Content
The following flow measurement techniques are considered:
- wind tunnel techniques and estimation of turbulence intensity
- hot wire calibration am measrement
- 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:
Teilnahme an mindestens 7 der 9 Termine, erfolgreiche Eingangskolloquien vor jedem Versuch und Abgabe eines aussagekräftigen Versuchsprotokolls nach jedem Experiment

Participation in at least 7 out of 9 events, successful initial colloquium prior to the respective measurements and submission of a significant report after every experiment

Empfehlungen:
Kenntnisse der Vorlesung "Experimentelle Strömungsmechanik" (LVNr. 2154446)
The content of lecture "Experimental Fluid Mechanics" (LVNr. 2154446)

Literature
Literatur:
10.145 Course: Flows and Heat Transfer in Energy Technology [T-MACH-105403]

**Responsible:** Prof. Dr.-Ing. Xu Cheng

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102608 - Major Field: Nuclear Energy
- M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology
- M-MACH-102635 - Major Field: Engineering Thermodynamics

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

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<td>Tutorial 'Flows and Heat Transfer in Energy Technology'</td>
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**Exams**

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</table>

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

**Competence Certificate**

oral exam, 20 min

**Prerequisites**

none
10.146 Course: Flows with Chemical Reactions [T-MACH-105422]

**Responsible:** apl. Prof. Dr. Andreas Class  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering  
- M-MACH-102634 - Major Field: Fluid Mechanic  
- M-MACH-102635 - Major Field: Engineering Thermodynamics

### Events

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**Exams**

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<th>Recurrence</th>
<th>Version</th>
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<td>ST 2021</td>
<td>76-T-MACH-105422</td>
<td>Flows with Chemical Reactions</td>
<td>Class</td>
<td></td>
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</table>

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

### Competence Certificate

- oral exam, duration 30 minutes
- Auxiliary: none

### Prerequisites

- none

### Recommendation

- Fluid Mechanics (T-MACH-105207)
- Mathematical Methods in Fluid Mechanics (T-MACH-105295)

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

#### Flows with chemical reactions

**Lecture (V)**  
2153406, WS 21/22, 2 SWS, Language: German/English, Open in study portal

**Content**

The students can describe flow scenarios, where a chemical reaction is confined to a thin layer. They can choose simplifying approaches for the underlying chemistry and discuss the problems with focus on the fluid mechanic aspects. The students are able to solve simple problems analytically. Furthermore, they are qualified to discuss simplifications as relevant for an efficient numerical solution of complex problems.

In the lecture we mainly consider problems, where chemical reaction is confined to a thin layer. The problems are solved analytically or they are at least simplified allowing for efficient numerical solution procedures. We apply simplified chemistry and focus on the fluid mechanic aspects of the problems.

**Literature**

- Vorlesungsskript


**Responsible:** Prof. Dr.-Ing. Markus Uhlmann

**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences

**Part of:** M-MACH-102634 - Major Field: Fluid Mechanic

---

**Type**  
Oral examination

**Credits**  
6

**Grading scale**  
Grade to a third

**Recurrence**  
Each term

**Version**  
1

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### Events

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<td>Fluid Mechanics of Turbulent Flows</td>
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### Exams

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<th>Credits</th>
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<td>ST 2021</td>
<td>8244110841</td>
<td>Fluid Mechanics of Turbulent Flows</td>
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</table>

**Competence Certificate**

oral exam, appr. 45 min.

**Prerequisites**

none

**Recommendation**

none

**Annotation**

none
10.148 Course: Fluid Power Systems [T-MACH-102093]

**Responsible:** Prof. Dr.-Ing. Marcus Geimer
Felix Pult

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102627 - Major Field: Energy Converting Engines
- M-MACH-102630 - Major Field: Mobile Machines
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
- M-MACH-102742 - Fundamentals and Methods of Production Technology
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

**Events**

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

**Competence Certificate**
The assessment consists of a written exam (90 minutes) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

**Prerequisites**
none

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

**Fluid Technology**

2114093, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**

Blended (On-Site/Online)

**Content**

In the range of hydrostatics the following topics will be introduced:

- Hydraulic fluids
- Pumps and motors
- Valves
- Accessories
- Hydraulic circuits.

In the range of pneumatics the following topics will be introduced:

- Compressors
- Motors
- Valves
- Pneumatic circuits.

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

**Literature**

Skriptum zur Vorlesung *Fluidtechnik*
Institut für Fahrzeugsystemtechnik
downloadbar
10.149 Course: Fluid-Structure-Interaction [T-MACH-105474]

**Responsible:** Prof. Dr.-Ing. Bettina Frohnapfel  
Dr.-Ing. Mark-Patrick Mühlhausen

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102634 - Major Field: Fluid Mechanic

<table>
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<td>ST 2021</td>
<td>2154453</td>
<td>Fluid-Structure-Interaction with Python</td>
<td>2 SWS</td>
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**Exams**

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<th>Type</th>
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<td>Fluid-Structure-Interaction</td>
<td>Mühlhausen</td>
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</table>

**Legend:**  
 tà Online, Ñ Blended (On-Site/Online), Ô On-Site, ✗ Canceled

**Competence Certificate**

oral exam 30 minutes

**Prerequisites**

none

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

**Fluid-Structure-Interaction with Python**

2154453, SS 2021, 2 SWS, Language: German, [Open in study portal](#)  

**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
10.150 Course: Fluid-Structure-Interaction with Python [T-MACH-111507]

Responsible: Dr.-Ing. Mark-Patrick Mühlhausen
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102634 - Major Field: Fluid Mechanic

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

Events

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<td>2</td>
<td>each summer term</td>
<td>1 terms</td>
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Mühlhausen


courses in the study portal

Competence Certificate
oral exam (appr. 30 minutes)

Prerequisites
none

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

Fluid-Structure-Interaction with Python
2154453, SS 2021, 2 SWS, Language: German, Open in study portal

Content
The lecture provides the basics for the description and modeling of flows, structures and their interaction. 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
10.151 Course: Foundations of Nonlinear Continuum Mechanics [T-MACH-105324]

Responsible: apl. Prof. Marc Kamlah
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102646 - Major Field: Applied Mechanics

<table>
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Events

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<td>2 SWS</td>
<td>Foundations of nonlinear continuum mechanics</td>
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<td>Foundations of Nonlinear Continuum Mechanics</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
oral exam

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

Foundations of nonlinear continuum mechanics
2181720, WS 21/22, 2 SWS, Language: German, Open in study portal
Lecture (V) On-Site

Content
The lecture is organized in three parts. In the first part, the mathematical foundations of tensor algebra and tensor analysis are introduced, usually in cartesian representation. In the second part of the lecture, the kinematics, i.e. the geometry of deformation is presented. Besides finite deformation, geometric linearization is discussed. The third part of the lecture deals with the physical balance laws of thermomechanics. It is shown, how a special classical theory of continuum mechanics can be derived by adding a corresponding constitutive model. For the illustration of the theory, elementary examples are discussed repeatedly.

The students understand the fundamental structure of a continuum theory consisting of kinematics, balance laws and constitutive model. In particular, they recognize non-linear continuum mechanics as a common structure including all continuum theories of thermomechanics, which are obtained by adding a corresponding constitutive model. The students understand in detail the kinematics of finite deformation and know the transition to the geometrically linear theory they are familiar with. The students know the spatial and material representation of the theory and the different related tensors. The students take the balance laws as physical postulates and understand their respective physical motivation.

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

Literature
Vorlesungsskript
10.152 Course: Foundry Technology [T-MACH-105157]

**Responsible:** Dr.-Ing. Christian Wilhelm

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102611 - Major Field: Materials Science and Engineering
- M-MACH-102618 - Major Field: Production Technology
- M-MACH-102628 - Major Field: Lightweight Construction

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**Prerequisites**
Materials Science I & II must be passed.

**Competence Certificate**
oral exam; about 25 minutes

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

**Foundry Technology**
2174575, SS 2021, 2 SWS, Language: German, [Open in study portal](#) Lecture (V) Blended (On-Site/Online)
Content
Moulding and casting processes
Solidifying of melts
Castability
Fe-Alloys
Non-Fe-Alloys
Moulding and additive materials
Core production
Sand reclamation
Design in casting technology
Casting simulation
Foundry Processes

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

requirements:
Required: Material Science and Engineering I and II

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

Organizational issues
Vorlesungstermine: 23.4., 30.4., 7.5., 21.5., 11.6., 18.6., 2.7., 16.7.

Literature
Literaturhinweise werden in der Vorlesung gegeben
Reference to literature, documentation and partial lecture notes given in lecture
### Course: Fuels and Lubricants for Combustion Engines [T-MACH-105184]

**Responsible:** Hon.-Prof. Dr. Bernhard Ulrich Kehrwald  
Dr.-Ing. Heiko Kubach

**Organisation:** KIT Department of Mechanical Engineering

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

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

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

**Prerequisites**
none

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

#### Fuels and Lubricants for Combustion Engines

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

**Lecture (V) On-Site**

**Content**
Introduction and basics

- Fuels for Gasoline and Diesel engines
- Hydrogen
- Lubricants for Gasoline and Diesel engines
- Coolants for combustion engines

**Literature**
Skript
10.154 Course: Fuels and Lubricants for Engine Powertrains [T-MACH-111623]

**Responsible:** Hon.-Prof. Dr. Bernhard Ulrich Kehrwald
Dr.-Ing. Heiko Kubach

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology
- M-MACH-102627 - Major Field: Energy Converting Engines
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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**Exams**

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

**Prerequisites**
none

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

**Fuels and Lubricants for Combustion Engines**
2133108, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Content**
- Introduction and basics
- Fuels for Gasoline and Diesel engines
- Hydrogen
- Lubricants for Gasoline and Diesel engines
- Coolants for combustion engines

**Literature**
Skript
10 COURSES

**10.155 Course: Fundamentals for Design of Motor-Vehicle Bodies I [T-MACH-102116]**

**Responsible:** Dipl.-Ing. Horst Dietmar Bardehle

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102605 - Major Field: Engineering Design
- M-MACH-102607 - Major Field: Vehicle Technology

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**Exams**

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Legend: 📲 Online, 🧩 Blended (On-Site/Online), 🗿 On-Site, ✗ Canceled

**Competence Certificate**

Oral group examination

**Duration:** 30 minutes

**Auxiliary means:** none

**Prerequisites**

none

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

**Fundamentals for Design of Motor-Vehicles Bodies I**

2113814, WS 21/22, 1 SWS, Language: German, [Open in study portal](#)

**Lecture (V) Online**

**Content**

1. History and design
2. Aerodynamics
3. Design methods (CAD/CAM, FEM)
4. Manufacturing methods of body parts
5. Fastening technology
6. Body in white / body production, body surface

**Learning Objectives:**

The students have an overview of the fundamental possibilities for design and manufacture of motor-vehicle bodies. They know the complete process, from the first idea, through the concept to the dimensioned drawings (e.g. with FE-methods). They have knowledge about the fundamentals and their correlations, to be able to analyze and to judge relating components as well as to develop them accordingly.

**Organizational issues**

Termine, nähere Informationen und eventuelle Terminänderungen: siehe 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

Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021
Module Handbook, valid from Winter Term 2021/2022
10.156 Course: Fundamentals for Design of Motor-Vehicle Bodies II [T-MACH-102119]

**Responsible:** Dipl.-Ing. Horst Dietmar Bardehle

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102605 - Major Field: Engineering Design
M-MACH-102607 - Major Field: Vehicle Technology

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**Events**

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<th>ST 2021</th>
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**Exams**

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<td>Bardehle</td>
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</tbody>
</table>

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

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**Competence Certificate**

Oral group examination

**Duration:** 30 minutes

**Auxiliary means:** none

**Prerequisites**

none

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

**Fundamentals for Design of Motor-Vehicles Bodies II**

2114840, SS 2021, 1 SWS, Language: German, Open in study portal

**Lecture (V)**

**Online**

---

**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.

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**Organizational issues**

Voraussichtliche Termine, nähere Informationen und evtl. Änderungen: siehe Institutshomepage.

Scheduled dates, further Information and possible changes of date: see homepage of the institute.

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**Literature**

2. Automobil Revue, Bern (Schweiz)
3. Automobil Produktion, Verlag Moderne Industrie, Landsberg
### Course: Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria [T-MACH-107670]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102611 - Major Field: Materials Science and Engineering

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<td>2 SWS</td>
<td>Lecture</td>
<td>Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</td>
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**Competence Certificate**  
Oral examination (about 30 min)

**Prerequisites**  
The successful participation in Übungen zu Thermodynamische Grundlagen / Heterogene Gleichgewichte is the condition for the admittance to the oral exam in Thermodynamische Grundlagen / Heterogene Gleichgewicht.

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

T-MACH-110925 – Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria has not been started.

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

1. The course T-MACH-107669 - Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria must have been passed.

**Recommendation**  
Basic course in materials science and engineering  
Basic course in mathematics  
Physics or physical chemistry

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

<table>
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**Legend:**  
🖥 Online,  🧩 Blended (On-Site/Online),  🗣 On-Site,  ❌ Cancelled
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.

Organizational issues
Aufgrund der derzeitigen Situation ("Corona-Krise") wird die Vorlesung online (Zoom) in einer Live-Version ab dem 20.10.21 zur Vorlesungszeit (mittwochs, 8:00-9:30 Uhr) angeboten. Einen entsprechenden Link hierfür finden Sie einige Tage vor Vorlesungsbeginn in ILIAS unter: "Einstellungen" --> "Kursinfo" --> "Wichtige Informationen".
Die Übungen zur Vorlesung finden 14-tägig in Präsenz statt (ab KW 43). Zeit und Ort gemäß Vorlesungsverzeichnis: Montags, 10:00 - 11:30 Uhr, 10.50 HS 102 sowie Dienstags, 14:00-15:30 Uhr, 50.41 Raum -108. Die genauen Termine werden in der ersten Vorlesung bekannt gegeben.
Es erfolgt eine entsprechende Gruppeneinteilung für die Übungen in der ersten Vorlesung.
Bitte seien Sie 10 Minuten vor Übungsbeginn am Hörsaal damit die Einhaltung der "3 G-Regel" überprüft werden kann. Danke.

Literature
Course: Fundamentals in the Development of Commercial Vehicles [T-MACH-111389]

Responsible: Dr. Christof Weber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102607 - Major Field: Vehicle Technology

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Events

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Exams

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

Competence Certificate
Oral group examination
Duration: appr. 30 minutes
Auxiliary means: none

Prerequisites
none

Annotation
Fundamentals in the Development of Commercial Vehicles I, WT
Fundamentals in the Development of Commercial Vehicles II, ST

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

Fundamentals in the Development of Commercial Vehicles II
2114844, SS 2021, 1 SWS, Language: German, Open in study portal

Content
1. Gear boxes of commercial vehicles
2. Intermediate elements of the drive train
3. Axle systems
4. Front axles and driving dynamics
5. Chassis and axle suspension
6. Braking System
7. Systems
8. Excursion

Learning Objectives:
The students know the advantages and disadvantages of different drives. Furthermore they are familiar with components, such as transfer box, propeller shaft, powered and non-powered front axle etc. Beside other mechanical components, such as chassis, axle suspension and braking system, also electric and electronic systems are known. Consequently the student are able to analyze and to judge the general concepts as well as to adjust them precisely with the area of application.

Organizational issues
Genaue Termine, nähere Informationen und eventuelle Terminänderungen:
siehe Institutshomepage.
Fundamentals in the Development of Commercial Vehicles I
2113812, WS 21/22, 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
Termine und Nähere Informationen: siehe Institutshomepage
Dates and further information will be published on the homepage of the institute.

Literature
Course: Fundamentals in the Development of Commercial Vehicles I [T-MACH-105160]

**10.159 Course: Fundamentals in the Development of Commercial Vehicles I [T-MACH-105160]**

**Responsible:** Dr. Christof Weber  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102605 - Major Field: Engineering Design  
- M-MACH-102630 - Major Field: Mobile Machines

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

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<th>Title</th>
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| WT 21/22 | 2113812 | Fundamentals in the Development of Commercial Vehicles I | 1 SWS | Lecture / 🖥

**Exams**

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<td>Fundamentals in the Development of Commercial Vehicles I</td>
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**Competence Certificate**

Oral group examination  
**Duration:** 30 minutes  
**Auxiliary means:** none

**Prerequisites**

none

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

**Fundamentals in the Development of Commercial Vehicles I**  
2113812, WS 21/22, 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**

Termine und Nähere Informationen: siehe Institutshomepage  
Dates and further information will be published on the homepage of the institute.
Literature


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

**Responsible:** Dr. Christof Weber  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:**  
- M-MACH-102605 - Major Field: Engineering Design  
- M-MACH-102630 - Major Field: Mobile Machines

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**Events**

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**Competence Certificate**

- Oral group examination

**Duration:** 30 minutes

**Auxiliary means:** none

**Prerequisites**

- none

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

**Fundamentals in the Development of Commercial Vehicles II**  
2114844, SS 2021, 1 SWS, Language: German, Open in study portal

**Content**

1. Gear boxes of commercial vehicles  
2. Intermediate elements of the drive train  
3. Axle systems  
4. Front axles and driving dynamics  
5. Chassis and axle suspension  
6. Braking System  
7. Systems  
8. Excursion

**Learning Objectives:**

The students know the advantages and disadvantages of different drives. Furthermore they are familiar with components, such as transfer box, propeller shaft, powered and non-powered front axle etc. Beside other mechanical components, such as chassis, axle suspension and braking system, also electric and electronic systems are known. Consequently the student are able to analyze and to judge the general concepts as well as to adjust them precisely with the area of application.

**Organizational issues**

Genaue Termine, nähere Informationen und eventuelle Terminänderungen: siehe Institutshomepage.
Literature
1. HILGERS, M.: Nutzfahrzeugtechnik lernen, Springer Vieweg, ISSN: 2510-1803
10.161 Course: Fundamentals of Automobile Development I [T-MACH-105162]

**Responsible:** Hon.-Prof. Rolf Frech  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102605 - Major Field: Engineering Design  
M-MACH-102607 - Major Field: Vehicle Technology

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</table>

**Competence Certificate**

Written examination

**Duration:** 90 minutes

**Auxiliary means:** none

**Prerequisites**

none

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

**Fundamentals of Automobile Development I**

2113810, WS 21/22, 1 SWS, Language: German, [Open in study portal]

**Content**

1. Process of automobile development  
2. Conceptual dimensioning and design of an automobile  
3. Laws and regulations – National and international boundary conditions  
4. Aero dynamical dimensioning and design of an automobile I  
5. Aero dynamical dimensioning and design of an automobile II  
6. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines I  
7. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines II

**Learning Objectives:**

The students have an overview of the fundamentals of the development of automobiles. They know the development process, the national and the international legal requirements that are to be met. They have knowledge about the thermo-management, aerodynamics and the design of an automobile. They are ready to judge goal conflicts in the field of automobile development and to work out approaches to solving a problem.

**Organizational issues**

Termine und nähere Informationen finden Sie auf der Institutshomepage.

Kann nicht mit Lehrveranstaltung 2113851 kombiniert werden.

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

Cannot be combined with lecture 2113851.

**Literature**

Skript zur Vorlesung wird zu Beginn des Semesters ausgegeben

The scriptum will be provided during the first lessons
**Principles of Whole Vehicle Engineering I**
2113851, WS 21/22, 1 SWS, Language: English, [Open in study portal](#)

**Content**
1. Process of automobile development
2. Conceptual dimensioning and design of an automobile
3. Laws and regulations – National and international boundary conditions
4. Aero dynamical dimensioning and design of an automobile I
5. Aero dynamical dimensioning and design of an automobile II
6. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines I
7. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines II

**Learning Objectives:**
The students have an overview of the fundamentals of the development of automobiles. They know the development process, the national and the international legal requirements that are to be met. They have knowledge about the thermo-management, aerodynamics and the design of an automobile. They are ready to judge goal conflicts in the field of automobile development and to work out approaches to solving a problem.

**Organizational issues**
Termine und nähere Informationen finden Sie auf der Instituithomepage.
Dats and further information will be published on the homepage of the institute.
Kann nicht mit Lehrveranstaltung 2113810 kombiniert werden
Cannot be combined with lecture 2113810.

**Literature**
Skript zur Vorlesung wird zu Beginn des Semesters ausgegeben
The scriptum will be provided during the first lessons
10.162 Course: Fundamentals of Automobile Development II [T-MACH-105163]

**Responsible:** Hon.-Prof. Rolf Frech  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102605 - Major Field: Engineering Design  
M-MACH-102607 - Major Field: Vehicle Technology

<table>
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**Legends:**  
Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**  
Written examination

**Duration:** 90 minutes

**Auxiliary means:** none

**Prerequisites**

none

---

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

**Fundamentals of Automobile Development II**  
2114842, SS 2021, 1 SWS, Language: German, Open in study portal

**Content**

1. Application-oriented material and production technology I  
2. Application-oriented material and production technology II  
3. Overall vehicle acoustics in the automobile development  
4. Drive train acoustics in the automobile development  
5. Testing of the complete vehicle  
6. Properties of the complete automobile

**Learning Objectives:**

The students are familiar with the selection of appropriate materials and the choice of adequate production technology. They have knowledge of the acoustical properties of the automobiles, covering both the interior sound and exterior noise. They have an overview of the testing procedures of the automobiles. They know in detail the evaluation of the properties of the complete automobile. They are ready to participate competently in the development process of the complete vehicle.

**Organizational issues**

Vorlesung findet als Blockvorlesung statt.  
Kann nicht mit der Veranstaltung [2114860] kombiniert werden.  
Cannot be combined with lecture [2114860].

**Literature**

Skript zur Vorlesung ist über ILIAS verfügbar.
Principles of Whole Vehicle Engineering II
2114860, SS 2021, 1 SWS, Language: English, Open in study portal

Content
1. Application-oriented material and production technology I
2. Application-oriented material and production technology II
3. Overall vehicle acoustics in the automobile development
4. Drive train acoustics in the automobile development
5. Testing of the complete vehicle
6. Properties of the complete automobile

Learning Objectives:
The students are familiar with the selection of appropriate materials and the choice of adequate production technology. They have knowledge of the acoustical properties of the automobiles, covering both the interior sound and exterior noise. They have an overview of the testing procedures of the automobiles. They know in detail the evaluation of the properties of the complete automobile. They are ready to participate competently in the development process of the complete vehicle.

Organizational issues
Kann nicht mit der Veranstaltung [2114842] kombiniert werden.
Cannot be combined with lecture [2114842].
Raum 219, Geb. 70.04, Campus Ost.
Genaue Termine entnehmen Sie bitte der Institushomepage.
Scheduled dates:
see homepage of the institute.

Literature
Das Skript zur Vorlesung ist über ILIAS verfügbar.
10.163 Course: Fundamentals of Catalytic Exhaust Gas Aftertreatment [T-MACH-105044]

**Responsible:**
- Prof. Dr. Olaf Deutschmann
- Prof. Dr. Jan-Dierk Grunwaldt
- Dr.-Ing. Heiko Kubach
- Hon.-Prof. Dr. Egbert Lox

**Organisation:**
KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-102627 - Major Field: Energy Converting Engines
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

**Type**
- Oral examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each summer term

**Version**
- 1

**Events**

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**Exams**

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

**Prerequisites**
none

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

**Fundamentals of catalytic exhaust gas aftertreatment**
2134138, SS 2021, 2 SWS, Language: German, Open in study portal

**Organizational issues**
Blockvorlesung, Termin und Ort werden auf der Homepage des IFKM und ITCP bekannt gegeben.

**Literature**

10.164 Course: Fundamentals of Combustion Engine Technology [T-MACH-105652]

**Responsible:**
- Dr.-Ing. Sören Bernhardt
- Dr.-Ing. Heiko Kubach
- Jürgen Pfeil
- Dr.-Ing. Olaf Toedter
- Dr.-Ing. Uwe Wagner

**Organisation:**
KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology
- M-MACH-102627 - Major Field: Energy Converting Engines
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction

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**Exams**

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

**Competence Certificate**
oral exam, 30 min

**Prerequisites**
none

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

**Fundamentals of Combustion Engine Technology**
2133123, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Content**
Fundamentals of engine processes
Components of combustion engines
Mixture formation systems
Gas exchange systems
Injection systems
Exhaust Gas Aftertreatment Systems
Cooling systems
Ignition Systems
### 10.165 Course: Fundamentals of Combustion I [T-MACH-105213]

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

**Part of:**  
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering  
- M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102610 - Major Field: Power Plant Technology  
- M-MACH-102627 - Major Field: Energy Converting Engines  
- M-MACH-102635 - Major Field: Engineering Thermodynamics  
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering  
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology  
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

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**Exams**

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**Competition Certificate**

Written exam, approx. 3 hours

**Prerequisites**

none

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

**Fundamentals of Combustion I**

2165515, WS 21/22, 2 SWS, Language: German, Open in study portal

**Content**

- Fundamental concepts and phenomena  
- Experimental analysis of flames  
- Conservation equations for laminar flat flames  
- Chemical reactions  
- Chemical kinetics mechanisms  
- Laminar premixed flames  
- Laminar diffusion flames  
- Ignition processes  
- NOx formation  
- Formation of hydrocarbons and soot

**Literature**

Vorlesungsskript,  
Fundamentals of Combustion I (Tutorial)

2165517, WS 21/22, 1 SWS, Open in study portal

Literature

- Vorlesungsskript

Fundamentals of Combustion I

3165016, WS 21/22, 2 SWS, Language: English, Open in study portal

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,

10.166 Course: Fundamentals of Combustion II [T-MACH-105325]

Responsible: Dr. Viatcheslav Bykov
Prof. Dr. Ulrich Maas

Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology
- M-MACH-102627 - Major Field: Energy Converting Engines
- M-MACH-102635 - Major Field: Engineering Thermodynamics
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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Events

| ST 2021 | 2166538 | Fundamentals of combustion II | 2 SWS | Lecture / 📐 | Maas |
| ST 2021 | 2166539 | Übung zu Grundlagen der technischen Verbrennung II | 1 SWS | Practice / 📐 | Maas |
| ST 2021 | 3166550 | Fundamentals of Combustion II | 2 SWS | Lecture / 📐 | Maas, Bykov |

Exams

| ST 2021 | 76-T-MACH-105325 | Fundamentals of Combustion II | Maas |

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

Competence Certificate

Oral exam, approx. 20 min

Prerequisites

none

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

Fundamentals of combustion II
2166538, SS 2021, 2 SWS, Language: German, Open in study portal

Lecture (V)
Online

Content

- Three dimensional Navier-Stokes equations for reacting flows
- Turbulent reactive flows
- Turbulent non-premixed flames
- Turbulent premixed flames
- Combustion of liquid and solid fuels
- Engine knock
- Thermodynamics of combustion processes
- Transport phenomena
- Effects of Combustion Processes on the Atmosphere

Literature
Vorlesungsskript;

Übung zu Grundlagen der technischen Verbrennung II
2166539, SS 2021, 1 SWS, Language: German, Open in study portal

Practice (Ü)
Online

Content
Calculation and Simulation of combustion processes
Literature
Skript Grundlagen der technischen Verbrennung (I+II) von Prof. Dr. rer. nat. habil. U. Maas

Fundamentals of Combustion II
3166550, SS 2021, 2 SWS, Language: English, Open in study portal

Content
• Three dimensional Navier-Stokes equations for reacting flows
• Turbulent reactive flows
• Turbulent non-premixed flames
• Turbulent premixed flames
• Combustion of liquid and solid fuels
• Engine knock
• Thermodynamics of combustion processes
• Transport phenomena
• Effects of Combustion Processes on the Atmosphere

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

Literature
Vorlesungsskript;
10.167 Course: Fundamentals of Energy Technology [T-MACH-105220]

**Responsible:** Dr. Aurelian Florin Badea  
Prof. Dr.-Ing. Xu Cheng

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102623 - Major Field: Fundamentals of Energy Technology

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**Events**

| ST 2021 | 2130927 | Fundamentals of Energy Technology | 3 SWS | Lecture / 🖥 | Cheng, Badea |
| ST 2021 | 3190923 | Fundamentals of Energy Technology | 3 SWS | Lecture / 🖥 | Badea |

**Exams**

| ST 2021 | 76-T-MACH-105220 | Fundamentals of Energy Technology | Cheng, Badea |
| ST 2021 | 76-T-MACH-105220 Fundamentals of Energy Technology | Fundamentals of Energy Technology | Badea |
| WT 21/22 | 76-T-MACH-105220 | Fundamentals of Energy Technology | Badea, Cheng |

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

**Competence Certificate**

Written examination, 90 min

**Prerequisites**

none

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

**Fundamentals of Energy Technology**  
2130927, SS 2021, 3 SWS, Language: German, Open in study portal

**Content**

The objective of the course is to train the students on state of the art knowledge about the challenging fields of energy industry and the permanent competition between the economical profitability and the long-term sustainability. The students obtain basic knowledge on thermodynamics relevant to the energy sector and comprehensive knowledge on the energy sector: demand, energy types, energy mix, installations for energy production (conventional, nuclear and renewable), transport and energy storage, environmental impact and future tendencies. Students are able to use methods of economic efficiency optimization for the energy sector in a creative way, practice oriented, also specifically trained during the corresponding tutorial. The students are qualified for further training in energy engineering related fields and for (also research-related) professional activity in the energy sector.

The following relevant fields of the energy industry are covered:
- Energy demand and energy situation
- Energy types and energy mix
- Basics. Thermodynamics relevant to the energy sector
- Conventional fossil-fired power plants
- Combined Cycle Power Plants
- Cogeneration
- Nuclear energy
- Regenerative energies: hydropower, wind energy, solar energy, other energy systems
- Energy storage
- Transport of energy
- Power generation and environment. Future of the energy industry
Content
The objective of the course is to train the students on state of the art knowledge about the challenging fields of energy industry and the permanent competition between the economical profitability and the long-term sustainability. The students obtain basic knowledge on thermodynamics relevant to the energy sector and comprehensive knowledge on the energy sector: demand, energy types, energy mix, installations for energy production (conventional, nuclear and renewable), transport and energy storage, environmental impact and future tendencies. Students are able to use methods of economic efficiency optimization for the energy sector in a creative way, practice oriented, also specifically trained during the corresponding tutorial. The students are qualified for further training in energy engineering related fields and for (also research-related) professional activity in the energy sector.

The following relevant fields of the energy industry are covered:
- Energy forms
- Thermodynamics relevant to energy industry
- Energy sources: fossil fuels, nuclear energy, renewable sources
- Energy industry in Germany, Europe and worldwide
- Power generation and environment
- Evaluation of energy conversion processes
- Thermal/electrical power plants and processes
- Transport of energy / energy carriers
- Energy storage
- Systems utilizing renewable energy sources
- Basics of economic efficiency and calculus / Optimisation
- Future of the energy industry
10.168 Course: Fundamentals of reactor safety for the operation and dismantling of nuclear power plants [T-MACH-105530]

Responsible: Dr. Victor Hugo Sanchez-Espinoza
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102608 - Major Field: Nuclear Energy

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

Competence Certificate
oral exam about 30 minutes

Prerequisites
none

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

Fundamentals of reactor safety for the operation and dismantling of nuclear power plants

2190465, WS 21/22, 2 SWS, Language: German/English, Open in study portal

On-Site

Content
This lecture describes the fundamentals of reactor safety for both the operation and the decommissioning of nuclear power plants. The first part will be focused on reactor safety issues important for the operation of a NPP:

- Safety fundamentals as defense in depth, multi-barrier concepts
- Operational modes of nuclear power plants
- Main components for heat removal, safety systems of selected NPP designs
- Thermal characterization of the core and plant under normal operation conditions
- Accident analysis in nuclear power plants- initiation, methods of evaluations and safety implications

The second part of this lecture will be devoted to explain the neutron physical, radiation protection and safety aspects to be considered for the safe and economical decommissioning of nuclear power plants:

- Life cycle of a nuclear power plant and main strategies and challenges in the NPP decommissioning
- Physical processes responsible for the activation of reactor components during the operation of a nuclear power plant
- Radioactive waste generation in the core, classification and radiological relevance
- Waste classification, minimization methods and intermediate and final disposal
- Risk analysis and prevention, radiation protection issues and the regulatory framework for decommissioning
- Computational methods for the estimation of nuclei inventories, activation and dose rates of reactor components

Knowledge in energy technology, nuclear power plants, reactor physics, radiation protection is welcomed

Time of attendance: 30 hours
Self-study: 90 hours
oral examination: duration: about 30 minutes

Organizational issues
Anmeldung über ILIAS
Literature
Bibliography related to the Block Course “Fundamentals of Reactor Safety for the Operation and Dismantling of NPPs”

7. “Safe and effective nuclear power plant life cycle management towards decommissioning”, IAEA-TECDOC-1305.
10.169 Course: Fundamentals on High Frequency Techniques [T-ETIT-101955]

**Responsible:** Prof. Dr.-Ing. Thomas Zwick  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

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**Competence Certificate**

Success control is carried out as part of a written overall examination (120 minutes) of the selected courses, with which the minimum requirement for CP is met and the assessment of homework. Students can work on the homework exercises during the semester and submit them for correction. The handover is in handwritten form.

**Prerequisites**

none

**Recommendation**

Knowledge of the basics of high frequency technology is helpful.

**Annotation**

The module grade is the grade of the written exam. If at least 50% of the total points of the homework are achieved, the student receives a grade bonus of 0.3 or 0.4 grade points on passing the written exam. If the grade of the written exam is between 4.0 and 1.3, the bonus improves the grade of the written exam by one grade (0.3 or 0.4). The exact criteria for awarding a bonus will be announced at the beginning of the course.

The grade bonus once acquired will remain for a possible written examination in a later semester. The homework is a voluntary additional service, i.e. Even without the grade bonus, the full score or top grade can be achieved in the exam.
### Course: Fusion Technology A [T-MACH-105411]

**Responsible:** Prof. Dr. Robert Stieglitz  
**Organisation:** KIT Department of Mechanical Engineering

#### Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102610 - Major Field: Power Plant Technology  
- M-MACH-102643 - Major Field: Fusion Technology

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#### Events

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#### Exams

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

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

**Prerequisites**  
none

**Recommendation**  
appreciated is knowledge in heat and mass transfer as well as in electrical engineering,  
basic knowledge in fluid mechanics, material sciences and physics

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

#### Fusion Technology A

| 2169483, WS 21/22, 2 SWS, Language: German, Open in study portal |
| Lecture / Practice (VÜ) On-Site |
Content
To transfer the basic physical concepts of particle physics, fusion and nuclear fission; this includes fundamental questions such as how: What is a plasma? How can it be ignited? What is the difference between magnetic and inertial fusion? Based on this, aspects of the stability of plasmas, their control and particle transport are discussed. After characterizing the plasma, the "fire" of fusion, the confinement in magnetic fields is sketched, which are built up with the help of magnetic technology. Here, knowledge of superconductivity, production and design of magnets is imparted. A reactor operation with a plasma as energy source requires a continuous operation of a tritium and fuel cycle, which is generated by the fusion reactor itself. Since fusion plasmas require small material densities, vacuum technology plays a central role. Finally, the heat generated in the fusion power plant must be converted into a power plant process and the reaction products removed. The functional basics and the structure of these fusion-typical in-vessel components are presented and the current challenges and the state of the art are demonstrated.

The course describes the essential functional principles of a fusion reactor, beginning with plasma, magnet technology, the tritium and fuel cycle, vacuum technology and the associated material sciences. The physical basics will be taught and the engineering laws of scaling will be demonstrated. Special importance is attached to the understanding of the interfaces between the different subject areas, which essentially determine the engineering technical interpretations. Methods for identifying and evaluating the central parameters will be demonstrated. Based on the acquired perception skills, methods for the design of solution strategies will be taught and technical solutions will be identified, their weak points discussed and evaluated.

Recommendations/Pre-knowledge:
Basic knowledge of fluid mechanics, materials engineering and physics. Knowledge of heat and mass transfer and electrical engineering is helpful.
Presence time: 21 h
Self-study: 90 h
Oral examination:
Duration: approx. 30 minutes, aids: none

Organizational issues
Die Veranstaltung wird nur online gehalten, falls durch Corona Einschränkungen vorgegeben werden.

Literature
Innerhalb jedes Teilblockes wird eine Literaturliste der jeweiligen Fachliteratur angegeben. Zusätzlich erhalten die Studenten/-innen das Studienmaterial in gedruckter und elektronischer Version.
10.171 Course: Fusion Technology B [T-MACH-105433]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102643 - Major Field: Fusion Technology

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<td>Übungen zu Fusionstechnologie B</td>
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**Legend:** 🗣 Online, 🖥 Blended (On-Site/Online), 🗣 On-Site, x Cancelled

**Competence Certificate**

oral exam of about 30 minutes

**Prerequisites**

none

**Recommendation**

attendance of fusion technology A lecture

reliable capability to use fundamental knowledge communicated in the bachelor study in physics, material sciences, electrical engineering and engineering design

**Annotation**

none

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

**Fusion Technology B**

2190492, SS 2021, 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
### Course: Gasdynamics [T-MACH-105533]

**Responsible:** Dr.-Ing. Franco Magagnato  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering  
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology  
- M-MACH-102627 - Major Field: Energy Converting Engines  
- M-MACH-102634 - Major Field: Fluid Mechanic  
- M-MACH-102635 - Major Field: Engineering Thermodynamics  
- M-MACH-102636 - Major Field: Thermal Turbomachines  
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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**Exams**

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**Competence Certificate**

- oral exam - 30 minutes

**Prerequisites**

- none

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

**Gasdynamics**

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**Lecture (V)**

- Blended (On-Site/Online)

**Content**

The student can describe the governing equations of Gas Dynamics and the associated basics in Thermodynamics. He will know different flow phenomena of applied Gas Dynamics. He can calculate compressible flows analytically. He is familiar with the Rankine-Hugoniot curve. They can derive the continuity-, the momentum- and the energy equations in differential form. With the help of the stationary flow filament theory they can calculate the normal shock wave and the associated increase of the entropy along past the shock wave. They are able to calculate the stagnation values of the Gas Dynamical variables and to determine their critical values. The students can apply the flow filament theory for variable cross-sectional areas and can distinguish between the different flow fields inside the Laval nozzle that forms with different boundary conditions. He can calculate the values behind an oblique shock wave and can distinguish between detached and attached shock waves. The student can calculate the Prandtl-Meyer expansion wave.

This lecture covers the following topics:

- Introduction to gas dynamics
- Numerical and experimental examples
- Governing equations of gas dynamics
- The transport equations in differential and integral form
- Stationary flow filament theory with and without normal shock waves
- Discussion of the energy equation: Stagnation and critical values
- Flow filament theory at variable cross-sectional area. Flow inside a Laval nozzle
- Oblique shock waves, detached shock waves
- Prandtl-Meyer expansion wave
- Viscous flows (Fanno flow)
Literature
Zierep, J.: Theoretische Gasdynamik, Braun Verlag, Karlsruhe. 1991
### 10.173 Course: Gear Cutting Technology [T-MACH-102148]

**Responsible:** Dr.-Ing. Markus Klaiber  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102599 - Major Field: Powertrain Systems  
- M-MACH-102605 - Major Field: Engineering Design  
- M-MACH-102607 - Major Field: Vehicle Technology  
- M-MACH-102618 - Major Field: Production Technology  
- M-MACH-102627 - Major Field: Energy Converting Engines  
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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

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<td>Gear Technology</td>
<td>2 SWS</td>
<td>Online</td>
<td>Klaiber</td>
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<td>Gear Cutting Technology</td>
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<td>76-T-MACH-102148</td>
<td>Gear Technology</td>
<td>Klaiber</td>
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</tr>
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**Competence Certificate**

**Oral Exam (20 min)**

**Prerequisites**

None

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

**Gear Technology**

<table>
<thead>
<tr>
<th>Code</th>
<th>Language</th>
<th>Open in study portal</th>
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<tr>
<td>2149655</td>
<td>German</td>
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**Legend:**  
- 🖥 Online  
- 🧩 Blended (On-Site/Online)  
- 🗣 On-Site  
- ❌ Cancelled
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

Organizational issues
Start: 21.10.2021

Literature
Medien:
Skrift zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
10.174 Course: Global Logistics [T-MACH-111003]

**Responsible:** Prof. Dr.-Ing. Kai Furmans

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102618 - Major Field: Production Technology
- M-MACH-102629 - Major Field: Logistics and Material Flow Theory
- M-MACH-102640 - Major Field: Technical Logistics

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**Events**

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<td>2 SWS</td>
<td>Lecture</td>
<td>/ Blended (On-Site/Online)</td>
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<td>Exams</td>
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<td>Global Production and Logistics - Part 2: Global Logistics / New: Global Logistics</td>
<td>Furmans</td>
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**Competence Certificate**
The success control takes place in form of a written examination (60 min) during the semester break (according to §4(2), 1 SPO). If the number of participants is low, an oral examination (according to §4(2), 2 SPO) may also be offered.

**Prerequisites**
none

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

**Global Logistics**

2149600, SS 2021, 2 SWS, Language: German, [Open in study portal]

Lecture (V) Blended (On-Site/Online)
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 appropriate methods,
- describe requirements and characteristics of global trade and transport, and
- evaluate characteristics of the design from logistic chains regarding their suitability.

Exam:

The exam consists of a 60 minutes written examination (according to §4(2), 1 of the examination regulation).
The main exam is offered every summer semester. A second date for the exam is offered in winter semester only for students that did not pass the main exam.

Literature

Weiterführende Literatur:

- Arnold/Isermann/Kuhn/Tempelmeier. HandbuchLogistik, Springer Verlag, 2002 (Neuausgabe in Arbeit)
- Domschke. Logistik, Rundreisen und Touren, Oldenbourg Verlag, 1982
- Domschke/Drexl. Logistik, Standorte, OldenbourgVerlag, 1996
- Gudehus. Logistik, Springer Verlag, 2007
10.175 Course: Global Production [T-MACH-110991]

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

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102618 - Major Field: Production Technology  
M-MACH-102629 - Major Field: Logistics and Material Flow Theory

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<th>2 SWS</th>
<th>Lecture / 🧩</th>
<th>Lanza</th>
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<th>Global Production</th>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), ☞ On-Site, ✗ Cancelled

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

**Prerequisites**  
T-MACH-108848 - Globale Produktion und Logistik - Teil 1: Globale Produktion must not be commenced.  
T-MACH-105158 - Globale Produktion und Logistik - Teil 1: Globale Produktion must not be commenced.  
T-MACH-110337 - Globale Produktion und Logistik must not be commenced.

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

1. The course T-MACH-110337 - Global Production and Logistics must not have been started.

**Recommendation**  
Participation in "T-MACH-110981 - Tutorial Global Production" is recommended, but not mandatory.

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

**Global Production**  
2149613, WS 21/22, 2 SWS, Language: German, Open in study portal  
Lecture (V)  
Blended (On-Site/Online)
Content
The lecture examines the management of global production networks of manufacturing companies. It gives an overview of the influencing factors and challenges of global production. In-depth knowledge of common methods and procedures for planning, designing and managing global production networks is imparted.

Therefore, the lecture first of all discusses the connections and interdependencies between the business strategy and the production strategy and illustrates necessary tasks for the definition of a production strategy. Methods for site selection, for the site-specific adaptation of product design and production technology as well as for the establishment of new production sites and for the adaptation of existing production networks to changing framework conditions are subsequently taught within the context of the design of the network footprint. With regard to the management of global production networks, the lecture addresses challenges associated with coordination, procurement and order management in global networks. The lecture is complemented by a discussion on the use of industry 4.0 applications in global production and current trends in planning, designing and managing global production networks.

The topics include:

- Basic conditions and influencing factors of global production (historical development, targets, chances and threats)
- Framework for planning, designing and managing global production networks
- Production strategies for global production networks
  - From business strategy to production strategy
  - Tasks of the production strategy (product portfolio management, circular economy, planning of production depth, production-related research and development)
- Design of global production networks
  - Basic types of network structures
  - Planning process for the design of the network footprint
  - Adaptation of the network footprint
  - Site selection
  - Location-specific adaptation of production technology and product design
- Management of global production networks
  - Network coordination
  - Procurement process
  - Order management
- Trends in planning, designing and managing global production networks

Learning Outcomes:
The students ...

- can explain the general conditions and influencing factors of global production
- are capable to apply defined procedures for site selection and to evaluate site decisions with the help of different methods
- are able to select the adequate scope of design for site-appropriate production and product construction cases specifically
- can state the central elements in the planning process of establishing a new production site.
- are capable to make use of the methods to design and scale global production networks for company-individual problems
- are able to show up the challenges and potentials of the departments sales, procurement as well as research and development on global basis.

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

Recommendations:
Combination with Global Production and Logistics – Part 2

Organizational issues
Start: 18.10.2021
Vorlesungstermine montags 14:00 - 15:30 Uhr
Lectures on Mondays 14:00 - 15:30
Literature
Medien
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt
empfohlene Sekundärliteratur:

Media
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)
recommended secondary literature:
10.176 Course: Global Production and Logistics [T-MACH-110337]

**Responsible:** Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Gisela Lanza

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102618 - Major Field: Production Technology

**Type**
- Oral examination

**Credits**
- 8

**Grading scale**
- Grade to a third

**Version**
- 1

**Events**

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

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<td>Global Production and Logistics</td>
<td>Furmans, Lanza</td>
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<td>WT 21/22</td>
<td>76-T-MACH-110337</td>
<td>Global Production and Logistics</td>
<td>Furmans, Lanza</td>
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**Legend:**
- 🖥 Online
- 🎫 Blended (On-Site/Online)
- 🗣 On-Site
- 🗑 Cancelled

**Competence Certificate**
- oral exam (40 min)

**Prerequisites**
The following courses must not be started:

- Globale Production and Logistics - Part 1: Global Production [T-MACH-105158 oder T-MACH-108848]
- Globale Production and Logistics - Part 2: Global Logistics [T-MACH-105159]

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

**Global Logistics**

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<th>Event Code</th>
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<td>Global Production and Logistics</td>
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**Legend:**
- 🖥 Online
- 🎫 Blended (On-Site/Online)
Content

Characteristics of global trade

- Incoterms
- Customs clearance, documents and export control

Global transport and shipping

- Maritime transport, esp. container handling
- Air transport

Modeling of supply chains

- SCOR model
- Value stream analysis

Location planning in cross-border-networks

- Application of the Warehouse Location Problem
- Transport Planning

Inventory Management in global supply chains

- Stock keeping policies
- Inventory management considering lead time and shipping costs

Media:

presentations, black board

Workload:

regular attendance: 21 hours
self-study: 99 hours

Students are able to:

- assign basic problems of planning and operation of global supply chains and plan them with appropriate methods,
- describe requirements and characteristics of global trade and transport, and
- evaluate characteristics of the design from logistic chains regarding their suitability.

Exam:

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- Domschke. Logistik, Rundreisen und Touren, Oldenbourg Verlag, 1982
- Domschke/Drexl. Logistik, Standorte, Oldenbourg Verlag, 1996
- Gudehus. Logistik, Springer Verlag, 2007
- Tempelmeier. Bestandsmanagement in SupplyChains, Books on Demand 2006
Content
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Therefore, the lecture first of all discusses the connections and interdependencies between the business strategy and the production strategy and illustrates necessary tasks for the definition of a production strategy. Methods for site selection, for the site-specific adaptation of product design and production technology as well as for the establishment of new production sites and for the adaptation of existing production networks to changing framework conditions are subsequently taught within the context of the design of the network footprint. With regard to the management of global production networks, the lecture addresses challenges associated with coordination, procurement and order management in global networks. The lecture is complemented by a discussion on the use of industry 4.0 applications in global production and current trends in planning, designing and managing global production networks.

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  - Site selection
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- Management of global production networks
  - Network coordination
  - Procurement process
  - Order management
- Trends in planning, designing and managing global production networks

Learning Outcomes:
The students …

- can explain the general conditions and influencing factors of global production
- are capable to apply defined procedures for site selection and to evaluate site decisions with the help of different methods
- are able to select the adequate scope of design for site-appropriate production and product construction case-specifically
- can state the central elements in the planning process of establishing a new production site.
- are capable to make use of the methods to design and scale global production networks for company-individual problems
- are able to show up the challenges and potentials of the departments sales, procurement as well as research and development on global basis.

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

Recommendations:
Combination with Global Production and Logistics – Part 2

Organizational issues
Start: 18.10.2021
Vorlesungstermine montags 14:00 - 15:30 Uhr
Lectures on Mondays 14:00 - 15:30
Literature
Medien
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt
empfohlene Sekundärliteratur:
Media
Lecture notes will be provided in ilias (https://ilias.studium.kit.edu/)
recommended secondary literature:
**Course: Großdiesel- und -gasmotoren für Schiffsantriebe [T-MACH-110816]**

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

**Organisation:**
- **Part of:** M-MACH-102627 - Major Field: Energy Converting Engines
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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**Events**

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

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

**Prerequisites**

None

**Competence Certificate**

oral exam, 20 minutes

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

**Large Diesel and Gas Engines for Ship Propulsions**

2134154, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**

Blended (On-Site/Online)

**Content**

- Introduction and History
- Types of Ships and Propulsion Systems
- Thermodynamic
- Boosting
- Design
- Fuels
- Lubricants
- Injection of liquid Fuels
- Combustion Processes for liquid Fuels
- Injection of Gaseous Fuels
- Combustion Processes for Gaseous Fuels
- Emissions
- Integration of Engines in Ships
- Large Engines in other Applications
Course: Handling Characteristics of Motor Vehicles I [T-MACH-105152]

10.178 Course: Handling Characteristics of Motor Vehicles I [T-MACH-105152]

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

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics  
- M-MACH-102607 - Major Field: Vehicle Technology

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<td>Grade to a third</td>
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**Legend:** 🗣 On-Site, 🧩 Blended (On-Site/Online), 🖥 Online, ❌ Cancelled

**Competition Certificate**

**Verbally**

**Duration:** 30 up to 40 minutes

**Auxiliary means:** none

**Prerequisites**

none

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

**Handling Characteristics of Motor Vehicles I**

**Lecture (V)**

<table>
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<td>2</td>
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<td>Unrau</td>
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</table>

**Content**

1. Problem definition: Control loop driver - vehicle - environment (e.g. coordinate systems, modes of motion of the car body and the wheels)

2. Simulation models: Creation from motion equations (method according to D'Alembert, method according to Lagrange, programme packages for automatically producing of simulation equations), model for handling characteristics (task, motion equations)

3. Tyre behavior: Basics, dry, wet and winter-smooth roadway

**Learning Objectives:**

The students know the basic connections between drivers, vehicles and environment. They can build up a vehicle simulation model, with which forces of inertia, aerodynamic forces and tyre forces as well as the appropriate moments are considered. They have proper knowledge in the area of tyre characteristics, since a special meaning comes to the tire behavior during driving dynamics simulation. Consequently they are ready to analyze the most important influencing factors on the driving behaviour and to contribute to the optimization of the handling characteristics.

**Literature**

10.179 Course: Handling Characteristics of Motor Vehicles II [T-MACH-105153]

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

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics  
M-MACH-102607 - Major Field: Vehicle Technology

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**Events**

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**Exams**

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

**Competence Certificate**

**Oral Examination**

Duration: 30 up to 40 minutes

**Auxiliary means:** none

**Prerequisites**

none

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

**Handling Characteristics of Motor Vehicles II**

| 2114838, SS 2021, 2 SWS, Language: German, Open in study portal |

**Content**

1. Vehicle handling: Bases, steady state cornering, steering input step, single sine, double track switching, slalom, cross-wind behavior, uneven roadway

2. Stability behavior: Basics, stability conditions for single vehicles and for vehicles with trailer

**Learning Objectives:**

The students have an overview of common test methods, with which the handling of vehicles is gauged. They are able to interpret results of different stationary and transient testing methods. Apart from the methods, with which e.g. the driveability in curves or the transient behaviour from vehicles can be registered, also the influences from cross-wind and from uneven roadways on the handling characteristics are well known. They are familiar with the stability behavior from single vehicles and from vehicles with trailer. Consequently they are ready to judge the driving behaviour of vehicles and to change it by specific vehicle modifications.

**Literature**

10.180 Course: Hands-on BioMEMS [T-MACH-106746]

**Responsible:** apl. Prof. Dr. Andreas Guber

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

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

**Competence Certificate**
Oral presentation and discussion (30 Min.)

**Prerequisites**
none
Course: Heat and Mass Transfer [T-MACH-105292]

Responsible: Prof. Dr. Ulrich Maas  
Dr.-Ing. Chunkan Yu

Organisation: KIT Department of Mechanical Engineering

Part of:  
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering  
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering  
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering  
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology  
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction  
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

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

Events

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Competence Certificate

Written exam, approx. 3 h

Prerequisites

none

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

Heat and Mass Transfer

3122512, SS 2021, 2 SWS, Language: English, Open in study portal

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 (condensation, evaporation)  
- Radiative heat transfer

Organizational issues

Bitte beachten Sie den Aushang.

Literature

- Maas ; Vorlesungsskript "Wärme- und Stoffübertragung"  
Content

- Steady and unsteady heat transfer in homogenous materials; Plates, pipe sections and spherical 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 (condensation, evaporation)
- Radiative heat transfer

Literature

- Maas ; Vorlesungsskript "Wärme- und Stoffübertragung"
10.182 Course: Heat Transfer in Nuclear Reactors [T-MACH-105529]

Responsible: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

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<td>Flow and heat transfer in nuclear reactors</td>
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Legend: ₹ Online, 3 Blended (On-Site/Online), 🗣 On-Site, x Cancelled

Competence Certificate
oral exam, 20 min

Prerequisites
none

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

Flow and heat transfer in nuclear reactors
2189907, WS 21/22, 2 SWS, Language: English, Open in study portal

Content
This lecture is designed for students of mechanical engineering and other engineering disciplines in their Bachelor or Master studies. The students will understand the most important heat transfer processes and learn the methods for the analysis of flow and heat transfer in nuclear reactors. Students are capable of explaining the thermal-hydraulic processes occurring in nuclear reactors and of selecting suitable models or simulation codes for thermal-hydraulic design and analysis.

1. Reactor types and thermal-hydraulic design criteria
2. Heat transfer processes and modeling
3. Pressure drop calculation
4. Temperature distribution in nuclear reactor
5. Numerical analysis methods for nuclear reactor thermal-hydraulics

Organizational issues
This compact English lecture will be given on October 11-13, 2021, 09:00-17:00.

Literature
1. L.S. Tong, J. Weisman, Thermal-hydraulics of pressurized water reactors, American Nuclear Society, La Grande Park, Illinois, USA
10.183 Course: Heatpumps [T-MACH-105430]

**Responsible:** Prof. Dr. Ulrich Maas  
Dr.-Ing. Heinrich Wirbser

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102635 - Major Field: Engineering Thermodynamics  
M-MACH-102648 - Major Field: Energy Technology for Buildings

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

**Competence Certificate**

Oral exam (20 min)

**Prerequisites**

none

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

**Heatpumps**  
2166534, SS 2021, 2 SWS, Language: German, [Open in study portal]

**Content**

The aim of this lecture is to promote heat pumps as heating systems for small and medium scale facilities and to discuss their advantages as well as their drawbacks. After considering the actual energy situation and the political requirements the different aspects of heat pumps are elucidated. The requirements concerning heat sources, the different components and the various types of heat pumps are discussed. In addition ecological and economical aspects are taken into consideration. The coupling of heat pumps with heat accumulators in heating systems will also be part of the lecture.

**Literature**

Vorlesungsunterlagen

Bach, K.: Wärmepumpen, Bd. 26 Kontakt und Studium, Lexika Verlag, 1979


**Heatpumps**  
2166534, WS 21/22, 2 SWS, Language: German, [Open in study portal]

**Content**

The aim of this lecture is to promote heat pumps as heating systems for small and medium scale facilities and to discuss their advantages as well as their drawbacks. After considering the actual energy situation and the political requirements the different aspects of heat pumps are elucidated. The requirements concerning heat sources, the different components and the various types of heat pumps are discussed. In addition ecological and economical aspects are taken into consideration. The coupling of heat pumps with heat accumulators in heating systems will also be part of the lecture.
**Literature**

Vorlesungsunterlagen

Bach, K.: Wärmepumpen, Bd. 26 Kontakt und Studium, Lexika Verlag, 1979


**10.184 Course: High Performance Computing [T-MACH-105398]**

**Responsible:** Prof. Dr. Britta Nestler  
Dr.-Ing. Michael Selzer  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

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

**Competence Certificate**

At the end of the semester, there will be a written exam (90 min).

**Prerequisites**

none

**Recommendation**

preliminary knowledge in mathematics, physics and materials science  
regular participation in the additionally offered computer exercises

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

**High Performance Computing**

2183721, WS 21/22, 2 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**

Online

**Content**

Topics of the high performance computing course are:

- architectures of parallel platforms
- parallel programming models
- performance analysis of concurrent programs
- parallelization models
- MPI and OpenMP
- Monte-Carlo method
- 1D & 2D heat diffusion
- raycasting
- n-body problem
- simple phase-field models

The student

- can explain the foundations and strategies of parallel programming
- can efficiently apply high performance computers for simulations by elaborating respective parallelisation techniques.
- has an overview of typical applications and the specific requirements for parallelization.
- knows the concepts of parallelisation and is capable to apply these to efficiently use high performance computing resources and the growing performance of multi core processors in science and industry.
- has experiences in programming of parallel algorithms through integrated computer exercises.

preliminary knowledge in mathematics, physics and materials science recommended

regular attendance: 22.5 hours lecture, 11.5 hours exercises  
self-study: 116 hours

We regularly discuss exercises at the computer.

At the end of the semester, there will be a written exam.
Organizational issues
Termine für die Vorlesung HPC im WS 2021/2022 werden noch bekannt gegeben.

Literature

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

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

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

**Type**
- Oral examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each summer term

**Version**
- 1

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

**Competence Certificate**

oral exam, 20-30 min

**Prerequisites**

none

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

---

**Advanced powder metals**

2126749, SS 2021, 2 SWS, Language: German, Open in study portal

**Literature**

- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005
10.186 Course: High Temperature Corrosion [T-MACH-111458]

Responsible: Prof. Dr.-Ing. Bronislava Gorr
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102611 - Major Field: Materials Science and Engineering

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

Competence Certificate
oral exam (about 30 minutes)

Prerequisites
none

Recommendation
Knowledge from the basic materials science lecture

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

High Temperature Corrosion
2193050, WS 21/22, 2 SWS, Language: German, [Open in study portal]

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

Content
Oral examination (about 30 min)

Teaching content:
- High temperature functional and structural materials
- Thermodynamic fundamentals
- Kinetics and oxidation rate laws
- Defects in oxides
- Carl Wagner oxidation theory
- Oxidation of alloys
- Internal corrosion
- Protective coatings

Qualification targets:
The students gain fundamental understanding about underlying oxidation mechanisms of pure metals and complex alloys and acquire knowledge about ways to intrinsically protect high temperature materials by changing their chemical composition or/and atmospheric conditions as well as by applying protective coatings.

Recommendations:
Basic course in materials science and engineering and the course *Introduction to high temperature materials* (Gorr)

Organizational issues
Anmeldung verbindlich bis zum 20.10.2021 unter s.deubig@kit.edu und bronislava.gorr@kit.edu

Die Vorlesung findet in Präsenz statt. Zeit und Ort gemäß Vorlesungsverzeichnis: Donnerstag, 10:00 - 11:30 Uhr, Geb. 30.35 HS

Aufgrund der derzeitigen Situation ("Corona-Krise") bitten wir Sie, 10 Minuten vor Vorlesungsbeginn am Hörsaal zu sein da das KIT stichprobenartig kontrolliert damit die Einhaltung der "3 G-Regel" überprüft werden kann. Vielen Dank.

Literature
## 10.187 Course: High Temperature Materials [T-MACH-105459]

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

### Organisation:
KIT Department of Mechanical Engineering

### Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102611 - Major Field: Materials Science and Engineering
- M-MACH-102649 - Major Field: Advanced Materials Modelling

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### Exams

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

### Competence Certificate

Oral exam, about 25 minutes

### Prerequisites
None

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

### 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

**Responsible:** Prof. Dr.-Ing. Tamim Asfour  
Hon.-Prof. Dr. Uwe Spetzger

**Organisation:** KIT Department of Informatics

**Part of:**  
- M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering  
- M-MACH-102615 - Major Field: Medical Technology

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**Exams**

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Legend:  
- Online
- Blended (On-Site/Online)
- On-Site
- Cancelled
10.189 Course: Human Factors Engineering I [T-MACH-105518]

**Responsible:** Prof. Dr.-Ing. Barbara Deml

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102600 - Major Field: Man - Technology - Organisation
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
- M-MACH-102742 - Fundamentals and Methods of Production Technology

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</table>

**Exams**

| ST 2021 | 76-T-MACH-105518 | Human Factors Engineering I | Deml |
| WT 21/22 | 76-T-MACH-105518 | Human Factors Engineering I | Deml |

**Competence Certificate**

written exam, 60 minutes

The exams are only offered in German!

**Prerequisites**

none

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

**Human Factors Engineering I: Ergonomics**

2109035, WS 21/22, 2 SWS, Language: German, Open in study portal

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

In the second half of the semester, beginning with 2021/12/15, the course "Human Factors Engineering II: Work Organisation" takes place on Wednesday and Thursday.

Content of teaching:
1. Principles of human work
2. Behavioural-science data acquisition
3. workplace design
4. work environment design
5. work management
6. labour law and advocacy groups

Learning target:
The students acquire a basic knowledge in the field of ergonomics:

- They are able to consider cognitive, physiological, anthropometric, and safety technical aspects in order to design workplaces ergonomically.
- Just as well they know physical and psycho-physical fundamentals (e. g. noise, lighting, climate) in the field of work-environmental design.
- Furthermore the students are able to evaluate workplaces by knowing and being able to apply essential methods of time studies and payment systems.
- Finally, they get a first, overall insight into the German labour law as well as into the organisation of advocacy groups beyond companies.

Further on the participants get to know basic methods of behavioral-science data acquisition (e. g. eye-tracking, ECG, dual-task-paradigm).

Organizational issues

In der zweiten Hälfte des Semesters, ab dem 15.12.2021, findet die Veranstaltung "Arbeitswissenschaft II: Arbeitsorganisation" am Mittwoch und Donnerstag statt.

- schriftliche Prüfung
- Die Vorlesung hat einen Arbeitsaufwand von 120 h (=4 LP).

Literature
Die Kursmaterialien stehen auf ILIAS zum Download zur Verfügung.
10.190 Course: Human Factors Engineering II [T-MACH-105519]

**Responsible:** Prof. Dr.-Ing. Barbara Deml

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102600 - Major Field: Man - Technology - Organisation

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**Exams**

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**Legend:** 🤖 Online, 🧩 Blended (On-Site/Online), 🗺 On-Site, ❌ Cancelled

**Competence Certificate**
- written exam, 60 minutes
  - The exams are only offered in German!

**Prerequisites**
- none

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

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**Human Factors Engineering II: Work Organisation**

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

In the second half of the semester, beginning with 2021/12/15, the course "Human Factors Engineering II: Work Organisation" takes place on Wednesday and Thursday.

Content of teaching:
1. Fundamentals of work organization
2. Empirical research methods
3. Individual level
   - personnel selection
   - personnel development
   - personnel assessment
   - work satisfaction/motivation
4. Group level
   - interaction and communication
   - management of employees
   - team work
5. Organizational level
   - structural organization
   - process organization
   - production organization

Learning target:
The students gain a first insight into empirical research methods (e. g. experimental design, statistical data evaluation). Particularly, they acquire a basic knowledge in the field of work organisation:

- **Organizational level.** Within this module the students gain also a fundamental knowledge in the field of structural, process, and production organization.
- **Group level.** Besides, they get to know basic aspects of industrial teamwork and they know relevant theories in the field of interaction and communication, the management of employees as well as work satisfaction and motivation.
- **Individual level.** Finally, the students get to know also methods in the field of personnel selection, development, and assessment.

Organizational issues

In der zweiten Hälfte des Semesters, ab dem 15.12.2021, findet die Veranstaltung "Arbeitswissenschaft II: Arbeitsorganisation" am Mittwoch und Donnerstag statt.

- schriftliche Prüfung
- Die Vorlesung hat einen Arbeitsaufwand von 120 h (≈4 LP).

Literature
Die Kursmaterialien stehen auf ILIAS zum Download zur Verfügung.
10.191 Course: Human Factors Engineering II [T-MACH-110652]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102596 - Compulsory Elective Subject Economics/Law

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Exams

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</table>

Competence Certificate

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

Prerequisites
none
10 COURSES

Course: Human Factors Engineering III: Empirical research methods [T-MACH-105830]

<table>
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<tr>
<th>Responsible</th>
<th>Prof. Dr.-Ing. Barbara Deml</th>
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<td>KIT Department of Mechanical Engineering</td>
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Part of: M-MACH-102600 - Major Field: Man - Technology - Organisation

### Type
- Examination of another type

### Credits
- 4

### Grading scale
- Grade to a third

### Recurrence
- Each summer term

### Version
- 1

#### Events

| ST 2021 | 2110036 | Human Factors Engineering III: Empirical research methods | 2 SWS | Seminar / 🖥 | Deml |

#### Exams

| ST 2021 | 76-T-MACH-105830 | Human Factors Engineering III: Empirical research methods | Deml |

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

### Competence Certificate

Scientific report (about 6 pages), poster, and presentation

### Prerequisites

In order to attend this lecture, it is necessary having completed "Arbeitwissenschaft I" or "Arbeitwissenschaft II" successfully.

### Modeled Conditions

You have to fulfill one of 2 conditions:

1. The course T-MACH-105518 - Human Factors Engineering I must have been passed.
2. The course T-MACH-105519 - Human Factors Engineering II must have been passed.

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

- **Human Factors Engineering III: Empirical research methods**
  - 2110036, SS 2021, 2 SWS, Language: German, Open in study portal

### Content

The aim of the course is for participants to become familiar with and apply research methods in occupational science. For this purpose, the participants will receive an introduction to the basics of experimental design and they will learn essential methods of data collection and statistical data analysis. Subsequently, the participants will conduct, evaluate and present their own experimental studies on the topics of driver behavior and driving simulation.

Weekly face-to-face attendance at lecture sessions as well as small group sessions in the lab is mandatory. Depending on how the corona situation unfolds, the course will be present or online.

In addition, an approximately six-page research report and presentation are required as part of the course.

### Organizational issues

10.193 Course: Human-Machine-Interaction [T-INFO-101266]

**Responsible:** Prof. Dr.-Ing. Michael Beigl  
**Organisation:** KIT Department of Informatics  
**Part of:**  
- M-MACH-102598 - Major Field: Advanced Mechatronics  
- M-MACH-102614 - Major Field: Mechatronics

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**Events**

| ST 2021 | 24659 | Human-Computer-Interaction | 2 SWS | Lecture / 🖥 | Beigl |

**Exams**

| ST 2021 | 7500048 | Human-Machine-Interaction | Beigl |
| WT 21/22 | 7500076 | Human-Machine-Interaction | Beigl |

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

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-INFO-106257 - Human-Machine-Interaction Pass must have been passed.
# 10.194 Course: Human-Machine-Interaction Pass [T-INFO-106257]

**Responsible:** Prof. Dr.-Ing. Michael Beigl  
**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-102598 - Major Field: Advanced Mechatronics  
M-MACH-102614 - Major Field: Mechatronics

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## Events

| ST 2021 | 2400095   | Human-Computer-Interaction | 1 SWS | Practice / 🖥 | Beigl |
| ST 2021 | 24659     | Human-Computer-Interaction | 2 SWS | Lecture / 🖥  | Beigl |

## Exams

| ST 2021 | 7500121   | Human-Machine-Interaction | | Beigl |

**Legend:** 🖥 Online, 🛠 Blended (On-Site/Online), 🔅 On-Site, ✗ Cancelled
Course: Humanoid Robots - Practical Course [T-INFO-105142]

**Responsible:** Prof. Dr.-Ing. Tamim Asfour  
**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-102633 - Major Field: Robotics

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**Exams**

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

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

**Humanoid Robotics Laboratory**

24890, WS 21/22, 4 SWS, Language: German/English, Open in study portal

**Practical course (P)**

Blended (On-Site/Online)

**Content**

In this practical course, a is worked on alone or in small teams with up to 3 students. Questions of humanoid robotics are dealt with, such as semantic scene interpretation, active perception, planning of grasping and manipulation tasks, action representation with motion primitives, and programming by demonstration.

The project work (alone or in groups) is performed largely independently but supported by scientific staff of the H2T. At the end of the practical course, the work has to be documented and presented in a scientific talk.

**Learning Objectives:**

- Students will be able to independently understand, structure, analyze, and solve a complex humanoid robotics problem using existing programming skills, alone or in a small team.
- Students can convey complex technical content in a presentation.

**Recommendation:**

- Very good programming skills in at least one high-level programming language are strongly recommended.
- Attendance of the lectures Robotics 1, Robotics 2, Robotics 3, as well as the robotics practical course are recommended.
- Project-specific recommendations (knowledge of C++, Python, ...) will be announced in the individual project descriptions

**Organizational issues**

Die Erfolgskontrolle erfolgt in Form einer mündlichen Prüfung nach § 4 Abs. 2 Nr. 2 SPO.

Die Modulnote ist die Note der mündlichen Prüfung.

Zielgruppe: Das Praktikum richtet sich an Studierende der Informatik, Elektrotechnik, Maschinenbau, Mechatronik im Masterstudium sowie alle Interessenten an der Robotik.

**Arbeitsaufwand:**

6 LP entspricht ca. 180h, davon

1. 10h Präsenzzeit in Praktikumsbesprechungen
2. 10h Vor- und Nachbereitung derselben
3. 150h Selbststudium zur Bearbeitung des Themas

ca. 10h Vorbereitung und Halten eines wissenschaftlichen Vortrags
10.196 Course: Human-oriented Productivity Management: Personnel Management [T-MACH-106374]

Responsible: Dr.-Ing. Patricia Stock
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102600 - Major Field: Man - Technology - Organisation
- M-MACH-102613 - Major Field: Lifecycle Engineering
- M-MACH-102618 - Major Field: Production Technology

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Events

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

Competence Certificate
oral exam (approx. 20 min)
The exam is offered in German only!

Prerequisites
Timely pre-registration in ILIAS, since participation is limited.

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

**Human-oriented Productivity Management: Personnel Management**

2109021, SS 2021, 2 SWS, Language: German, Open in study portal

Block (B) Cancelled
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
Da das ganze Sommersemester 2021 komplett digital stattfinden soll, muss diese Präsenzveranstaltung leider abgesagt werden.

Literature
Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.
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
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   - 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

- Teilnehmerbeschränkung; die Vergabe der Plätze erfolgt nach dem Zeitpunkt der Anmeldung
- Anwesenheitspflicht für die gesamte Vorlesung
- Für eine verbindliche Kursteilnahme ist die Prüfungsanmeldung bis zwei Wochen vor Veranstaltungsbeginn im ifab-Sekretariat nachzuweisen.
- nur für Studierende im Master-Studium
- Mündliche Prüfung (ca. 20 Minuten)

Literature
Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.
### 10.197 Course: Hybrid and Electric Vehicles [T-ETIT-100784]

**Responsible:** Dr.-Ing. Klaus-Peter Becker  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:**  
- M-MACH-102599 - Major Field: Powertrain Systems  
- M-MACH-102607 - Major Field: Vehicle Technology  
- M-MACH-102614 - Major Field: Mechatronics

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#### Exams

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**Prerequisites**  
none
10.198 Course: Hydraulic Fluid Machinery [T-MACH-105326]

Responsible: Dr. Balazs Pritz
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102627 - Major Field: Energy Converting Engines

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

Competence Certificate
oral exam, 40 min.

Prerequisites
None.

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

1. Introduction
2. Basic equations
3. System analysis
4. Elementary Theory (Euler's equation of Fluid Machinery)
5. Operation and Performance Characteristics
6. Similarities, Specific Values
7. Control technics
8. Wind Turbines, Propellers
9. Cavitation
10. Hydrodynamic transmissions and converters

2157432 (Hydraulic Machinery) can not be combined with the event 2157451 (Wind and Hydropower)

Recommendations:
2153412 Fluid mechanics

Students get to know the basics of hydraulic fluid machinery (pumps, fans, hydroturbines, windturbines, hydrodynamic transmissions) in general. Application of the knowledge in different fields of engineering.

The lecture introduces the basics of Hydraulic Fluid Machinery. The different types and shapes are presented. The basic equations for the preservation of mass, momentum and energy are discussed. Velocity schemes in typical cascades are shown, the Euler equation of fluid machinery and performance characteristics are deduced. Similarities and dimensionless parameters are discussed. Fundamental aspects of operation and cavitation are shown.

Students are able to understand the working principle of Hydraulic Fluid Machinery as well as the interaction with typical systems, in which they are integrated.

regular attendance: 56 hours
self-study: 150 hours
preparation for exam: 40 hours
Oral or written examination (see announcement)

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

Literature

1. Fister, W.: Fluidenergiemaschinen I & II, Springer-Verlag
2. Bohl, W.: Strömungsmaschinen I & II . Vogel-Verlag
6. Kreiselpumpenlexikon. KSB Aktiengesellschaft

Responsibility: apl. Prof. Dr. Andreas Class
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102634 - Major Field: Fluid Mechanics

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

Events

| ST 2021 | 2154437 | Hydrodynamic Stability: From Order to Chaos | 2 SWS | Lecture / Online | Class |

Exams

| ST 2021 | 76-T-MACH-105425 | Hydrodynamic Stability: From Order to Chaos | Class |

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

Competence Certificate
oral exam, Duration: 30 minutes
Auxiliary means: none

Prerequisites
The partial performance number T-MACH-108846 - "Stability: From Order to Chaos" (Nat/Inf/Elit) must not be startet or completed. The partial services T-MACH-108846 - "Stability: From Order to Chaos" (Nat/Inf/Elit) and T-MACH-105425 - "Hydrodynamic Stability: From Order to Chaos" are mutually exclusive.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-108846 - Stability: from Order to Chaos must not have been started.

Recommendation
Fluid Mechanics (T-MACH-105207)
Mathematical Methods in Fluid Mechanics (T-MACH-105295)

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

Hydrodynamic Stability: From Order to Chaos
2154437, SS 2021, 2 SWS, Language: German/English, Open in study portal

Content
The students can apply the analytic and numerical methods for an evaluation of stability properties of hydrodynamic systems. The are qualified to discuss the characteristic influence of parameter changes (e.g. Reynolds number) on the calculated results with respect to the flow character and properties (e.g. transition laminar/turbulent flow).

Increasing a control parameter of a thermohydraulic system, e.g. the Reynolds number, the initial flow pattern (e.g. stationary flow) can be replaced by a different pattern (e.g. turbulent flow).

Typical hydrodynamic instabilities are summarized in the lecture.

The systematic analysis of thermohydraulic stability problems is developed for the case of Rayleigh-Bernard convection (fluid layer heated from below) and selected examples from fluid dynamics.

Covered:

• linear stability analysis: determine limiting control parameter value up to which the basic flow pattern is stable against small perturbations
• nonlinear reduced order modeling, capable to characterize more complex flow patterns
• Lorenz system: a generic system exhibiting chaotic behavior

Literature
Vorlesungsskript
10.200 Course: Hydrogen and reFuels - Energy Conversion in Combustion Engines [T-MACH-111585]

Responsible: Dr.-Ing. Heiko Kubach
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-102627 - Major Field: Energy Converting Engines
- M-MACH-102635 - Major Field: Engineering Thermodynamics
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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

Competence Certificate
oral exam, appr. 25 minutes, no auxiliary means

Prerequisites
none
10 Course: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement [T-MACH-110957]

Responsible: Prof. Dr. Astrid Pundt
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102611 - Major Field: Materials Science and Engineering
         M-MACH-102649 - Major Field: Advanced Materials Modelling

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Exams

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

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
T-MACH-110923 - Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung has not been started
T-MACH-108853 - Wasserstoff in Materialien has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110923 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement must not have been started.

Annotation
in German

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

Hydrogen in Materials: from energy storage to hydrogen embrittlement
2174572, SS 2021, 2 SWS, Language: German, Open in study portal

Content

learning objectives:
requirements:
workload:

Organizational issues
Die Vorlesung wird online angeboten. Teilnahme nach Anmeldung.

Literature
Literaturhinweise und Unterlagen in der Vorlesung
10 COURSES

Course: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement [T-MACH-110923]

Responsible: Prof. Dr. Astrid Pundt
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102611 - Major Field: Materials Science and Engineering

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Prerequisites

- T-MACH-108853 - Wasserstoff in Materialien has not been started
- T-MACH-110957 - Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung has not been started

Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-110957 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement must not have been started.

Competence Certificate

Oral exam, about 25 minutes

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

Annotation

in English

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

Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement
2173588, WS 21/22, 2 SWS, Language: English, Open in study portal

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

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

Literature
Literaturhinweise und Unterlagen in der Vorlesung
10.203 Course: Hydrogen Technologies [T-MACH-105416]

 Responsible: Dr. Thomas Jordan
 Organisation: KIT Department of Mechanical Engineering

 Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
 M-MACH-102610 - Major Field: Power Plant Technology

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Events

| ST 2021 | 2170495 | Hydrogen Technologies | 2 SWS | Lecture / 📞 | Jordan |

Exams

| ST 2021 | 76-T-MACH-105416 | Hydrogen Technologies | Jordan |

Legend: 📞 Online, 🧩 Blended (On-Site/Online), 🗂 On-Site, ❌ Cancelled

Competence Certificate
oral exam, Duration: approximately 30 minutes
Auxiliary: no tools or reference materials may be used during the exam

Prerequisites
none

Recommendation
Fundamentals Thermodynamics

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

Hydrogen Technologies
2170495, SS 2021, 2 SWS, Language: German, Open in study portal

Content
The course content is the cross-cutting issue of hydrogen as energy carrier. After successful participation the students may reflect on the fundamental technological basis of an energy system using predominantly hydrogen as an energy carrier or energy storage. Based on this knowledge they may objectify the principle idea of an hydrogen economy. The students know the fundamental physical and chemical properties of hydrogen and may apply their knowledge on thermodynamics to compare efficiencies of different solutions with hydrogen. They can list, compare and evaluate established and future solutions for production, storage and distribution of hydrogen. They can explain advantages and disadvantages of using hydrogen in conventional combustion processes versus using hydrogen in different fuel cells. In particular 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
10.204 Course: Ignition Systems [T-MACH-105985]

**Responsible:** Dr.-Ing. Olaf Toedter

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102627 - Major Field: Energy Converting Engines
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

### Events

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

**Competence Certificate**

oral exam, 20 min

**Prerequisites**

none

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

**Ignition systems**

2133125, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Content**

- Ignition Process
- Spark Ignition
- Principle of Spark Ignition Systems
- Limits of Spark Ignition
- New Developments of Spark Ignition Systems
- New an Alternative Ignition Systems
### 10.205 Course: Industrial Aerodynamics [T-MACH-105375]

**Responsible:** Prof. Dr.-Ing. Thomas Breitling  
Prof. Dr.-Ing. Bettina Frohnapfel  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics  
M-MACH-102607 - Major Field: Vehicle Technology  
M-MACH-102634 - Major Field: Fluid Mechanic

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**Type**  
Oral examination

**Credits**  
4

**Grading scale**  
Grade to a third

**Recurrence**  
Each winter term

**Version**  
1

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**Events**

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**Exams**

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

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**Competence Certificate**  
oral exam - 30 minutes

**Prerequisites**
none

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

**Industrial aerodynamics**

2153425, WS 21/22, 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 - Die Anmeldung im Sekretariat ist bis zum 11.02.2022 erforderlich

**Literature**

Vorlesungsskript
10.206 Course: Information Engineering [T-MACH-102209]

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102613 - Major Field: Lifecycle Engineering

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**Exams**

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**Competence Certificate**  
Alternative exam assessment (written composition and speech)

**Prerequisites**  
None

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

**Information Engineering**  
2122014, SS 2021, 2 SWS, Language: German/English, Open in study portal  
Seminar (S) Blended (On-Site/Online)

**Content**  
Seminar papers on current research topics of the Institute for Information Management in Engineering. The respective topics are presented at the beginning of each semester.

**Organizational issues**  
Siehe ILIAS-Kurs

**Literature**  
Themenspezifische Literatur
**10.207 Course: Information Processing in Sensor Networks [T-INFO-101466]**

**Responsible:** Prof. Dr.-Ing. Uwe Hanebeck  
**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-102609 - Major Field: Cognitive Technical Systems  
M-MACH-102624 - Major Field: Information Technology

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<th>Lecturer(s)</th>
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<tbody>
<tr>
<td>WT 21/22</td>
<td>24102</td>
<td>Information Processing in Sensor Networks</td>
<td>3 SWS</td>
<td>Lecture</td>
<td>🧩</td>
<td>Pfaff, Mayer</td>
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</table>

**Exams**

<table>
<thead>
<tr>
<th>Term</th>
<th>Code</th>
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<th>Credit</th>
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<tr>
<td>ST 2021</td>
<td>7500011</td>
<td>Information Processing in Sensor Networks</td>
<td>Hanebeck, Noack</td>
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<tr>
<td>WT 21/22</td>
<td>7500030</td>
<td>Information Processing in Sensor Networks</td>
<td>Pfaff</td>
<td></td>
</tr>
</tbody>
</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
10.208 Course: Information Systems and Supply Chain Management [T-MACH-102128]

Responsible: Dr.-Ing. Christoph Kilger
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102624 - Major Field: Information Technology
M-MACH-102625 - Major Field: Information Technology of Logistic Systems
M-MACH-102629 - Major Field: Logistics and Material Flow Theory

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

Events

<table>
<thead>
<tr>
<th>Events</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Type</th>
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</thead>
<tbody>
<tr>
<td>ST 2021 2118094</td>
<td>Information Systems in Logistics and Supply Chain Management</td>
<td>2 SWS</td>
<td>Lecture / Online</td>
<td>Written examination</td>
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<tr>
<td>Exams</td>
<td>76-T-MACH-102128</td>
<td>Information Systems and Supply Chain Management</td>
<td>Mittwollen</td>
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<tr>
<td>WT 21/22 76T-MACH-102128</td>
<td>Information Systems and Supply Chain Management</td>
<td>Mittwollen</td>
<td></td>
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</tr>
</tbody>
</table>

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

Competence Certificate
The success control takes place in form of a written examination (60 min) during the semester break (according to §4(2), 1 SPO). If the number of participants is low, an oral examination (according to §4 (2), 2 SPO) may also be offered.

Prerequisites
none

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

Information Systems in Logistics and Supply Chain Management
2118094, SS 2021, 2 SWS, Language: German, Open in study portal

Literature

**Responsible:** Prof. Dr.-Ing. Xu Cheng  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102608 - Major Field: Nuclear Energy  
- M-MACH-102610 - Major Field: Power Plant Technology

<table>
<thead>
<tr>
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<td>Grade to a third</td>
<td>Each summer term</td>
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<table>
<thead>
<tr>
<th>Events</th>
<th>Credits</th>
<th>Prerequisites</th>
<th>Organisational issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST 2021 2130973 Innovat</td>
<td>2 SWS</td>
<td></td>
<td>Mo (26.07.2021), Di (27.07.2021), Mi (28.07.2021), 09:00 bis 17:00</td>
</tr>
</tbody>
</table>

**Competence Certificate**  
oral exam, 20 min

**Prerequisites**  
none

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

**Innovative Nuclear Systems**  
2130973, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**  
This lecture is addressed to students of mechanical engineering, chemical engineering and physics. Goal of the lecture is the explanation of state-of-the-art development of nuclear systems. Nuclear systems, that are from today's point of view promising will be presented and explained. The main characteristics of such systems and the associated challenges are also part of the lecture.

1. state of the art and development tendencies in nuclear systems  
2. advanced concepts in light water cooled systems  
3. new developments in fast reactors  
4. development tendencies in gas-cooled plants  
5. transmutation systems for waste management  
6. fusion systems

**Organizational issues**  
Mo (26.07.2021), Di (27.07.2021), Mi (28.07.2021), 09:00 bis 17:00
10.210 Course: Innovative Project [T-MACH-109185]

**Responsible:** apl. Prof. Dr. Andreas Class  
Prof. Dr. Orestis Terzidis

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104323 - Major Field: Innovation and Entrepreneurship

<table>
<thead>
<tr>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<tbody>
<tr>
<td>Examination of another type</td>
<td>6</td>
<td>Grade to a third</td>
<td>Each winter term</td>
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**Events**

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<th>SWS</th>
<th>Language</th>
<th>Type</th>
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<tbody>
<tr>
<td>WT 21/22</td>
<td>2169466</td>
<td>Innovative Project</td>
<td>3</td>
<td>English</td>
<td>Blended (On-Site/Online)</td>
<td>Terzidis, Class</td>
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<tr>
<td>ST 2021</td>
<td>76-T-MACH-109185</td>
<td>Innovative Project</td>
<td>3</td>
<td>English</td>
<td>Class</td>
<td>Class</td>
</tr>
</tbody>
</table>

**Competence Certificate**

Students have to deliver pitch-talk supported by slides to convince a committee about their results. A fictive project proposal of 10 to 15 pages.

**Prerequisites**

none

**Recommendation**

Participates need to bring their own laptop with Skype installed.

Recommended English proficiency equivalent to:

- **IELTS** Academic test  
  An overall band score of at least 6.5 (with no section lower than 5.5)

- **University of Cambridge**  
  Certificate in Advanced English, CAE (grades A – C)
  Certificate of Proficiency in English, CPE (grades A – C)

- **TOEFL** Internet-based test, IBT  
  A total score of at least 92, with a minimum score of 22 from the writing section

**Annotation**

The subject of the project is provided by industry partner or the innovation department from KIT or INP Grenoble. Representatives of industry partner will be the addressee for the pitch-talk.

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

**Innovative Project**

2169466, WS 21/22, 3 SWS, Language: English, [Open in study portal](#)  
Blended (On-Site/Online)
Content
The lecture will be executed with the partner university INP Grenoble. Participants need to bring their own laptop with Skype installed. Teams of 2-3 students.

- Understand the physics of the technology of the invention considered in the project
- Understand the claims of the patent considered in the project
- Apply a structured technology application selection methodology.
- Student understand the methodology of TAS, which provides the background to become a TAS coach.
- Students are enabled to prepare a proposal for funding.

The TAS (technology application selection) methodology provides tools that help to successfully advance an invention with a low technology readiness level to a higher technology readiness level. Skills that are typically provided by a classical engineering education supports both the early phase of an invention where a deep basic understanding is required and the industrial exploration building on a first prototype. The gap that arises between the invention and its later industrialized application is rarely addressed, so that many inventions will not make it to the market. In the course, we practice bridging the technology gap for the case of a real invention provided by an industry partner or University. We experiment with teams consisting of team members located at different universities and from different disciplines.

The scenario addressed is an inventor who calls some of his friends within her/his personal network. The group will work remotely via video conference employing a structured TAS process. Creativity will be fertilized by teamwork and linking the invention to a selection of potential technologies. In an in-depth analysis of these links, each group narrows down their pool of ideas to one candidate. Finally, the group will try to convince the fellow teams (and the inventor) to support their idea. For this purpose, a pitch talk is prepared and delivered in front of all teams leading to a unique vote of all teams for one technology application. In addition the students prepare fictive proposals for start-up based on their TAS.

Organizational issues
please contact the lecturer and cc to heide.hofmann@kit.edu
10.211 Course: Integrated Information Systems for Engineers [T-MACH-102083]

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

Part of:
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
- M-MACH-102742 - Fundamentals and Methods of Production Technology

<table>
<thead>
<tr>
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<th>Grading scale</th>
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<tr>
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<td>Grade to a third</td>
<td>Each summer term</td>
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</table>

Events

ST 2021
- 2121001 Integrated Information Systems for engineers
  - 3 SWS
  - Lecture / Practice (🖥)
  - Ovtcharova, Elstermann

WT 21/22
- 2121001 Integrated Information Systems for engineers
  - 3 SWS
  - Lecture / Practice (🖥)
  - Ovtcharova, Elstermann

Exams

ST 2021
- 76-T-MACH-102083 Integrated Information Systems for Engineers
  - Ovtcharova, Elstermann

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

Competence Certificate
Oral examination 20 min.

Prerequisites
None

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

Integrated Information Systems for engineers
2121001, SS 2021, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ) Online

Content

- Information systems, information management
- CAD, CAP and CAM systems
- PPS, ERP and PDM systems
- Knowledge management and ontology
- Process modeling

Students can:

- illustrate the structure and operating mode of information systems
- describe the structure of relational databases
- describe the fundamentals of knowledge management and its application in engineering and deploy ontology as knowledge representation
- describe different types of process modelling and their application and illustrate and execute simple work flows and processes with selected tools
- explain different goals of specific IT systems in product development (CAD, CAP, CAM, PPS, ERP, PDM) and assign product development processes

Literature
Vorlesungsfolien / lecture slides

Integrated Information Systems for engineers
2121001, WS 21/22, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ) Online
Content

- Information systems, information management
- CAD, CAP and CAM systems
- PPS, ERP and PDM systems
- Knowledge management and ontology
- Process modeling

Students can:

- illustrate the structure and operating mode of information systems
- describe the structure of relational databases
- describe the fundamentals of knowledge management and its application in engineering and deploy ontology as knowledge representation
- describe different types of process modelling and their application and illustrate and execute simple work flows and processes with selected tools
- explain different goals of specific IT systems in product development (CAD, CAP, CAM, PPS, ERP, PDM) and assign product development processes

Literature

Vorlesungsfolien / lecture slides
Responsibility: Prof. Dr.-Ing. Albert Albers
Albers Assistenter

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102626 - Major Field: Integrated Product Development

<table>
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<td>4 SWS</td>
<td>Lecture / 🗣</td>
<td>Each winter term</td>
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<td>4 SWS</td>
<td>Practice / 🗣</td>
<td>Albers, Mitarbeiter</td>
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<td>WT 21/22 2145300</td>
<td>Project Work in Product Development</td>
<td>2 SWS</td>
<td>Others (sons / 🗣)</td>
<td>Albers</td>
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Exams
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Canceled

Competence Certificate
oral examination (60 minutes)

Prerequisites
none

Annotation
Due to organizational reasons, the number of participants is limited. Thus a selection has to be made. For registration to the selection process a standard form has to be used, that can be downloaded from IPEK homepage from april to july. The selection itself is made by Prof. Albers in personal interviews.

Below you will find excerpts from events related to this course:
Content
Registration required in the previous summer semester. The lecture starts in first week of October.

Prerequisites:
The participation in "Integrated Product Development" requires the concurrent participation in lectures (2145156), tutorials (2145157) and project work (2145300).

Due to organizational reasons, the number of participants is limited. Thus a selection has to be made. For registration to the selection process a standard form has to be used, that can be downloaded from IPEK homepage from April to July. The selection itself is made by Prof. Albers in personal interviews.

Recommendations:
none

Workload:
regular attendance: 84 h
self-study: 288 h

Examination:
oral examination (60 minutes)
combined examination of lectures, tutorials and project work

Course content:
organizational integration: integrated product engineering model, core team management and simultaneous engineering
informational integration: innovation management, cost management, quality management and knowledge management
personal integration: team coaching and leadership management
invited lectures

Learning objectives:
The Students are able to ...

- analyze and evaluate product development processes based on examples and their own experiences.
- plan, control and evaluate the working process systematically.
- choose and use suitable methods of product development, system analysis and innovation management under consideration of the particular situation.
- prove their results.
- develop complex technical solutions in a team and to present them to qualified persons as well as non-qualified persons
- to design overall product development processes under consideration of market-, customer- and company- aspects

Literature
Klaus Ehrlenspiel - Integrierte Produktentwicklung. Denkabläufe, Methodeneinsatz, Zusammenarbeit, Hanser Verlag, 2009

Workshop Product Development
2145157, WS 21/22, 4 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site
Content
Prerequisites:
The participation in "Integrated Product Development" requires the concurrent participation in lectures (2145156), tutorials (2145157) and project work (2145300).
Due to organizational reasons, the number of participants is limited to 42 persons. Thus a selection has to be made. For registration to the selection process a standard form has to be used, that can be downloaded from IPEK hompage from april to july. The selection itself is made by Prof. Albers in personal interviews.
Recommendations:
none
Workload:
regular attendance: 84 h
self-study: 288 h
Examination:
lectures: 21 h
preparation to exam: 99 h
Course content:
problem solving: analysis techniques, creativity techniques and evaluation methods
professional skills: presentation techniques, moderation and teamcoaching
development tools: MS Project, Szenario-Manager & Pro/Engineer Wildfire
Learning objectives:
The theoretical background taught in the lecture, is deepened through methodworkshops, business games and case studies. The reflexion of the onself procedure allows for an 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

<table>
<thead>
<tr>
<th>Project Work in Product Development</th>
<th>Others (sonst.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2145300, WS 21/22, 2 SWS, Language: German, Open in study portal</td>
<td>On-Site</td>
</tr>
</tbody>
</table>
Content
Participation only possible in combination with the lecture 2145156 'Integrated Product Development'.

Prerequisites:
The participation in "Integrated Product Development" requires the concurrent participation in lectures (2145156), tutorials (2145157) and project work (2145300).

Due to organizational reasons, the number of participants is limited to 42 persons. Thus a selection has to be made. For registration to the selection process a standard form has to be used, that can be downloaded from IPEK homepage from April to July. The selection itself is made by Prof. Albers in personal interviews.

Recommendations:
none

Workload:
regular attendance: 21 h
self-study: 99 h

Examination:
oral examination (60 minutes)
combined examination of lectures, tutorials and project work

Course content:
The project work begins with the early stages of product development, i.e. the identification of market trends and needs. Based on this information the students develop scenarios for future markets and create product profiles, which describe the customers and their demands without anticipating possible product solutions. After having passed several following milestones for ideas, concepts and designs, virtual prototypes and function prototypes are presented to an audience.
The project work is supported by coaching through skilled faculty staff. Additionally weekly tutorials, respectively workshops are given. For doing the project the teams gain access to team workspaces featuring IT-infrastructure and relevant software, such as office, CAD or FEA. Further on the teams learn how team cooperation and knowledge management can be supported in design project by using a wiki system.

Learning objectives:
The center of "Integrated Product Development" constitutes itself in the development of a technical product within independent working student teams on the basis of the market situation up to virtual and real prototypes. Thereby the integrate treatment of the product development process is of importance. The project teams hereby represent development departments of medium sized companies, in which the presented methods and tools are field - experienced applied and ideas are transformed into concrete product models.
For the preparation of this development project the basics of 3D-CAD-modelling (Pro/ENGINEER) as well as different tools and methods of creative designing, of sketching and solution finding are mediated in workshops. Special events impart an insight of presentation techniques and the meaning of technical design.
10.213 Course: Integrated Production Planning in the Age of Industry 4.0 [T-MACH-108849]

**Responsible:** Prof. Dr.-Ing. Gisela Lanza

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102618 - Major Field: Production Technology

### Type
- Oral examination

### Credits
- 8

### Grading scale
- Grade to a third

### Recurrence
- Each summer term

### Version
- 1

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#### Events

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<thead>
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<th>Code</th>
<th>Title</th>
<th>SWS</th>
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<td>2150660</td>
<td>Integrated Production Planning in the Age of Industry 4.0</td>
<td>6</td>
<td>Lecture / Practice (VÜ)</td>
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#### Exams

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<th>Code</th>
<th>Title</th>
<th>Type</th>
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<tbody>
<tr>
<td>ST 21</td>
<td>76-T-MACH-108849</td>
<td>Integrated Production Planning in the Age of Industry 4.0</td>
<td>Lanza</td>
</tr>
<tr>
<td>WT 21/22</td>
<td>76-T-MACH-108849</td>
<td>Integrated Production Planning in the Age of Industry 4.0</td>
<td>Lanza</td>
</tr>
</tbody>
</table>

**Legend:** 🌐 Online, 🧩 Blended (On-Site/Online), 💬 On-Site, ✗ Cancelled

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**Competence Certificate**
- Oral Exam (40 min)

**Prerequisites**
- "T-MACH-109054 - Integrierte Produktionsplanung im Zeitalter von Industrie 4.0" as well as "T-MACH-102106 Integrierte Produktionsplanung" must not be commenced.

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

<table>
<thead>
<tr>
<th>Event</th>
<th>Code</th>
<th>Title</th>
<th>Type</th>
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<tbody>
<tr>
<td>V</td>
<td>2150660</td>
<td>Integrated Production Planning in the Age of Industry 4.0</td>
<td>Lecture / Practice (VÜ)</td>
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</tbody>
</table>

**2150660, SS 2021, 6 SWS, Language: German, Open in study portal**

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Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021
Module Handbook, valid from Winter Term 2021/2022
Content
Integrated production planning in the age of industry 4.0 will be taught in the context of this engineering science lecture. In addition to a comprehensive introduction to Industry 4.0, the following topics will be addressed at the beginning of the lecture:

- Basics, history and temporal development of production
- Integrated production planning and integrated digital engineering
- Principles of integrated production systems and further development with Industry 4.0

Building on this, the phases of integrated production planning are taught in accordance with VDI Guideline 5200, whereby special features of parts production and assembly are dealt with in the context of case studies:

- Factory planning system
- Definition of objectives
- Data collection and analysis
- Concept planning (structural development, structural dimensioning and rough layout)
- Detailed planning (production planning and control, fine layout, IT systems in an industry 4.0 factory)
- Preparation and monitoring of implementation
- Start-up and series support

The lecture contents are rounded off by numerous current practical examples with a strong industry 4.0 reference. Within the exercises the lecture contents are deepened and applied to specific problems and tasks.

Learning Outcomes:
The students …

- can discuss basic questions of production technology.
- are able to apply the methods of integrated production planning they have learned about to new problems.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques they have learned about for a specific problem.
- can apply the learned methods of integrated production planning to new problems.
- can use their knowledge targeted for efficient production technology.

Workload:
MACH:
regular attendance: 63 hours
self-study: 177 hours

WING:
regular attendance: 63 hours
self-study: 207 hours

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/).
10.214 Course: Integrative Strategies in Production and Development of High Performance Cars [T-MACH-105188]

Responsible: Karl-Hubert Schlichtenmayer
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102605 - Major Field: Engineering Design
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-102618 - Major Field: Production Technology

<table>
<thead>
<tr>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<tbody>
<tr>
<td>Written examination</td>
<td>4</td>
<td>Grade to a third</td>
<td>Each summer term</td>
<td>1</td>
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</tbody>
</table>

Events

| ST 2021 | 2150601 | Integrative Strategies in Production and Development of High Performance Cars | 2 SWS | Lecture / Online | Schlichtenmayer |

Exams

| ST 2021 | 76-T-MACH-105188 | Integrative Strategies in Production and Development of High Performance Cars | Schlichtenmayer |

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

Competence Certificate
Written Exam (60 min)

Prerequisites
none

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

Integrative Strategies in Production and Development of High Performance Cars Lecture (V)
2150601, SS 2021, 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

Organizational issues
Die Vorlesung wird wöchentlich dienstags, 10:00 – 11:30 Uhr per Zoom stattfinden. Alle weiteren Informationen inkl. Link zur Zoom-Vorlesung finden Sie im ILIAS-Kurs.

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/).

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102598 - Major Field: Advanced Mechatronics  
M-MACH-102599 - Major Field: Powertrain Systems  
M-MACH-102601 - Major Field: Automation Technology  
M-MACH-102607 - Major Field: Vehicle Technology  
M-MACH-102610 - Major Field: Power Plant Technology  
M-MACH-102614 - Major Field: Mechatronics  
M-MACH-102615 - Major Field: Medical Technology  
M-MACH-102616 - Major Field: Microsystem Technology  
M-MACH-102618 - Major Field: Production Technology  
M-MACH-102633 - Major Field: Robotics  
M-MACH-102636 - Major Field: Thermal Turbomachines  
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools  
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

**Type**  
Oral examination

**Credits**  
4

**Grading scale**  
Grade to a third

**Recurrence**  
Each term

**Version**  
1

**Events**

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**Exams**

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

**Competence Certificate**

oral exam (20 min)

**Prerequisites**

none

**Recommendation**

None

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

**Patents and Patentstrategies in innovative companies**

2147160, SS 2021, 2 SWS, Language: German, Open in study portal
Content
Attendance at lectures (5 L): 24h
Personal preparation and follow-up of lecture and exercise: 5h
Preparation exam: 31h
The students understand and are able to describe the basics of intellectual property, particularly with regard to the filing and obtaining of property rights. They can name the criteria of project-integrated intellectual property management and strategic patenting in innovative companies. Students are also able to describe the key regulations of the law regarding employee invention and to illustrate the challenges of intellectual properties with reference to examples.

The lecture will describe the requirements to be fulfilled and how protection is obtained for patents, design rights and trademarks, with a particular focus on Germany, Europe and the EU. Active, project-integrated intellectual property management and the use of strategic patenting by technologically oriented companies will also be discussed. Furthermore, the significance of innovations and intellectual property for both business and industry will be demonstrated using practical examples, before going on to consider the international challenges posed by intellectual property and current trends in the sector. Within the context of licensing and infringement, insight will be provided as to the relevance of communication, professional negotiations and dispute resolution procedures, such as mediation for example. The final item on the agenda will cover those aspects of corporate law that are relevant to intellectual property.

Lecture overview:

1. Introduction to intellectual property
2. The profession of the patent attorney
3. Filing and obtaining intellectual property rights
4. Patent literature as a source of knowledge and information
5. The law regarding employee inventions
6. Active, project-integrated intellectual property management
7. Strategic patenting
8. The significance of intellectual property
9. International challenges and trends
10. Professional negotiations and dispute resolution procedures
11. Aspects of corporate law

Organizational issues
Weitere Informationen siehe IPEK-Homepage.
https://www.ipek.kit.edu/2976_2858.php
10.216 Course: International Production Engineering A [T-MACH-110334]

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

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102618 - Major Field: Production Technology

### Events

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<th>2 SWS</th>
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### Exams

| WT 21/22 | 76-T-MACH-110334 | International Production Engineering A | Fleischer |

**Legend:** 🖥 Online, 🍄 Blended (On-Site/Online), 📹 On-Site, ✗ Cancelled

---

**Competence Certificate**

Alternative test achievement (graded):
- Result of the project work and final presentation with weighting 65%
- Oral exam (ca. 15 min) with weighting 35%

**Prerequisites**

One of the following courses must be started:

- T-MACH-108844 - Automated Manufacturing Systems
- T-MACH-109055 - Machine Tools and Industrial Handling
- T-MACH-110962 - Machine Tools and High-Precision Manufacturing Systems

**Modeled Conditions**

You have to fulfill one of 3 conditions:

1. The course T-MACH-108844 - Automated Manufacturing Systems must have been started.
2. The course T-MACH-109055 - Machine Tools and Industrial Handling must have been started.
3. The course T-MACH-110962 - Machine Tools and High-Precision Manufacturing Systems must have been started.

**Recommendation**

This course should be attended in combination with International Production Engineering B in the next winter semester.

---

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

**International Production Engineering A**  
2150600, SS 2021, 2 SWS, Language: German/English, [Open in study portal](#)  
Lecture (V)  
Blended (On-Site/Online)
Content
The course "International Production Engineering" offers a practical insight into the development of production plants in an international environment. A student team works on a current and concrete problem in the field of production engineering, which is introduced into the project by an industrial partner who is operating as well in Germany as in China.

As part of the course "International Production Engineering A", the problem will initially be transferred into work packages. According to the elaborated project plan, ideas and concepts for a solution of the problem will be generated and developed. Based on the concepts, the selected solution approach is elaborated and validated, e.g. through simulation, programming and/or design, but always in the context of production technology. The practical implementation of the developed solution is part of the course "International Production Engineering B" during an eight-week research stay in China.

The project will be carried out by the students under the guidance of scientific staff and in cooperation with the industrial partner. The results of the project will be presented and discussed with the project partner in a final presentation (respectively IPE A and B).

More details about the course are discussed in an information event (always in January/February, the exact date is published on the homepage: www.wbk.kit.edu).

The project offers students …

- the unique opportunity to put the contents of the accompanying lecture into practice in an interdisciplinary and creative context,
- to gain insights into a wide range of development activities relevant for their future careers,
- cooperation with an attractive industrial partner,
- work in a team with other students with competent support from scientific staff,
- first practical experience in project management,
- international practical experience.

Learning Outcomes:
The students …

- can develop ideas for technical solutions in the environment of production plants in a team and evaluate their feasibility according to technical and economic criteria
- are capable of selecting the essential components and modules of a production plant and carrying out the necessary calculations
- can use FEM simulations to predict and evaluate the static and dynamic behavior of an assembly
- are able to present, plan and assess their own work and decision-making processes
- are able to apply basic methods of project management in an international environment.

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

Organizational issues

Die Vorlesung kann nur in Kombination mit der Lehrveranstaltung International Production Engineering B gehört werden.

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/).
10.217 Course: International Production Engineering B [T-MACH-110335]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102618 - Major Field: Production Technology

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Exams

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Competence Certificate

Alternative test achievement (graded):
- Result of the project work and final presentation with weighting 65%
- Oral exam (ca. 15 min) with weighting 35%

Prerequisites

The following course must be started:

- T-MACH-110334 - International Production Engineering A

Furthermore successful completion of one of the following courses:

- T-MACH-108844 - Automated Manufacturing Systems
- T-MACH-109055 - Machine Tools and Industrial Handling
- T-MACH-110962 - Machine Tools and High-Precision Manufacturing Systems

Modelled Conditions

The following conditions have to be fulfilled:

1. You have to fulfill one of 3 conditions:
   1. The course T-MACH-108844 - Automated Manufacturing Systems must have been passed.
   2. The course T-MACH-109055 - Machine Tools and Industrial Handling must have been passed.
   3. The course T-MACH-110962 - Machine Tools and High-Precision Manufacturing Systems must have been passed.
2. The course T-MACH-110334 - International Production Engineering A must have been started.

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

Die Vorlesung kann nur in Kombination mit International Production Engineering A gehört werden. Voraussetzung für die Vorlesung ist eine bestandene Prüfung in "Werkzeugmaschinen und Handhabungstechnik" oder "Automatisierte Produktionsanlagen" sowie die Teilnahme an der Lehrveranstaltung "International Production Engineering A" im vorhergehenden Sommersemester.

For organizational reasons, the number of participants in the course is limited. Hence, a selection process will take place. Applications can be made via the homepage of wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

The lecture can only be attended in combination with International Production Engineering A. Requirements for the lecture are a passed examination in "Machine Tools and Industrial Handling" or "Automated Production Systems" as well as a participation in the course "International Production Engineering A" in the previous summer semester.

Literature
Medien:
Unterlagen zur Veranstaltung werden über (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
Lecture documents will be provided in Ilias (https://ilias.studium.kit.edu/).
Course: Introduction into Mechatronics [T-MACH-100535]

**Responsible:** Moritz Böhland
apl. Prof. Dr. Markus Reischl

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102601 - Major Field: Automation Technology
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102615 - Major Field: Medical Technology
- M-MACH-102633 - Major Field: Robotics
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
- M-MACH-102615 - Major Field: Medical Technology
- M-MACH-102633 - Major Field: Robotics

**Type:** Written examination

**Credits:** 6

**Grading scale:** Grade to a third

**Recurrence:** Each winter term

**Version:** 2

**Events**
- WT 21/22 2105011 Introduction into Mechatronics 3 SWS Lecture / 🧩 Reischl, Böhland

**Exams**
- ST 2021 76-T-MACH-100535 Introduction into Mechatronics Reischl
- WT 21/22 76-T-MACH-100535 Introduction into Mechatronics Reischl

**Competence Certificate**
Oral exam (Duration: 2h)

**Prerequisites**
none

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

**Introduction into Mechatronics**
2105011, WS 21/22, 3 SWS, Language: German, Open in study portal

**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
10.219 Course: Introduction into the Multi-Body Dynamics [T-MACH-105209]

**Responsible:** Prof. Dr.-Ing. Wolfgang Seemann

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102599 - Major Field: Powertrain Systems
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
- M-MACH-102742 - Fundamentals and Methods of Production Technology
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
- M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems
- M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics

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**Competence Certificate**

Written examination, 180 min.

**Prerequisites**

none

**Recommendation**

Engineering Mechanics III/IV

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

**Introduction into the multi-body dynamics**

2162235, SS 2021, 3 SWS, Language: German, Open in study portal

**Content**

The role of multibody systems in engineering, kinematics of a single rigid body, Kinematics of multibody systems, rotation matrix, angular velocity, derivatives in different reference systems, holonomic and non-holonomic constraints, Newton-Euler's equations, principle of d'Alembert, principle of virtual power, Lagrange's equations, Kane's equations, structure of the equations of motion

**Literature**

Wittenburg, J.: Dynamics of Systems of Rigid Bodies, Teubner Verlag, 1977
Kane, T.: Dynamics of rigid bodies.
10.220 Course: Introduction to Ceramics [T-MACH-100287]

**Responsible:** Prof. Dr. Michael Hoffmann  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102611 - Major Field: Materials Science and Engineering  
- M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

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

**Competence Certificate**

The assessment consists of an oral exam (30 min) taking place at a specific date. The re-examination is offered at a specific date.

**Prerequisites**

None

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

**Introduction to Ceramics**  
2125757, WS 21/22, 3 SWS, Language: German, [Open in study portal](#)  
Lecture (V)  
On-Site

**Literature**

- Kingery, Bowen, Uhlmann, "Introduction To Ceramics", Wiley  
- Y.-M. Chiang, D. Birnie III and W.D. Kingery, "Physical Ceramics", Wiley  
- S.J.L. Kang, "Sintering, Densification, Grain Growth & Microstructure", Elsevier
10.221 Course: Introduction to High Temperature Materials [T-MACH-111258]

Responsible: Prof. Dr.-Ing. Bronislava Gorr
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102611 - Major Field: Materials Science and Engineering

<table>
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Exams

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Competence Certificate
oral examination (ca. 30 Minuten)

Prerequisites
none

Recommendation
Knowledge from the basic materials science lecture

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

**Introduction to High Temperature Materials**
2194724, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Content**

Oral examination (about 30 min)

Teaching content:

- Applications and requirements for high temperature materials
- High temperature corrosion (thermodynamics, oxidation kinetics, oxidation of alloys, protection of high temperature materials)
- Creep (creep curve, creep mechanisms, creep of solid-solution strengthened materials, creep of particle hardened alloys, life time prediction)
- Fatigue (fundamentals, life time prediction)
- Thermo-mechanical fatigue
- High-temperature materials (Ni-, Fe-, Co-Ti-based alloys, ODS materials)

Qualification targets:
The students acquire fundamental knowledge about high temperature corrosion, creep, high temperature fatigue and thermomechanical fatigue as well as resulting failure mechanisms.

Recommendations:
Basic course in materials science and engineering

**Organizational issues**

Or: online per MS Teams oder per Zoom

Anmeldung verbindlich bis zum 08.04.2021 unter bronislava.gorr@kit.edu

Nach der Anmeldung wird Ihnen der Link zur Vorlesung per E-Mail am 09.04.2021 mitgeteilt.

Termin: montags, 9:00-10:30 Uhr
Literature

- J. Young, High temperature oxidation and corrosion of metals, Elsevier, 2008
- Skript in elektronischer Form verfügbar.
Course: Introduction to Industrial Production Economics [T-MACH-105388]

**Responsible:** Simone Dürrschnabel

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102613 - Major Field: Lifecycle Engineering
- M-MACH-102618 - Major Field: Production Technology

<table>
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<th>Recurrence</th>
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<td>4</td>
<td>Grade to a third</td>
<td>Each summer term</td>
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</table>

**Competence Certificate**
oral exam (approx. 30 min)
The exam is offered in German only!

**Prerequisites**
none
10.223 Course: Introduction to Microsystem Technology - Practical Course [T-MACH-108312]

Responsible: Dr. Arndt Last
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course

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

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<td>Introduction to Microsystem Technology - Practical Course</td>
<td>2 SWS, Practical course</td>
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<td>WT 21/22</td>
<td>2143877</td>
<td>Introduction to Microsystem Technology - Practical Course</td>
<td>2 SWS, Practical course</td>
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Exams

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<td>Introduction to Microsystem Technology - Practical Course</td>
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</table>

Competence Certificate
non-graded written examination

Prerequisites
none

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

Introduction to Microsystem Technology - Practical Course

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<td>2143877</td>
<td>Introduction to Microsystem Technology - Practical Course</td>
<td>Practical course (P)</td>
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</table>

Content

In the practical training includes nine experiments:
1. Hot embossing of plastics micro structures
2. Micro electroforming
3. Mikro optics: "LIGA-micro spectrometer"
4. UV-lithography
5. Optical waveguides
6. Capillary electrophoresis on a chip
7. SAW gas sensor
8. Metrology
9. Atomic force microscopy
Each student takes part in only five experiments.
The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

Organizational issues

Teilnahmefragen an Frau Nowotny, marie.nowotny@kit.edu

Literature

Menz, W., Mohr, J.: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 1997
Unterlagen zum Praktikum zur Vorlesung 'Grundlagen der Mikrosystemtechnik'

Introduction to Microsystem Technology - Practical Course

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Literature

Menz, W., Mohr, J.: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 1997
Unterlagen zum Praktikum zur Vorlesung 'Grundlagen der Mikrosystemtechnik'

Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021
Module Handbook, valid from Winter Term 2021/2022
10.224 Course: Introduction to Microsystem Technology I [T-MACH-105182]

**Responsible:** Dr. Vlad Badilita  
Dr. Mazin Jouda  
Prof. Dr. Jan Gerrit Korvink  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102616 - Major Field: Microsystem Technology  
M-MACH-102647 - Major Field: Microactuators and Microsensors  
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology  
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction  
M-MACH-102742 - Fundamentals and Methods of Production Technology

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<td>Lecture / 🧱</td>
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**Exams**

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</table>

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

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

**Prerequisites**
none

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

**Introduction to Microsystem Technology I**

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

**Literature**

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

M. Madou  
Fundamentals of Microfabrication  
Taylor & Francis Ltd.; Auflage: 3. Auflage, 2011
Course: Introduction to Microsystem Technology II [T-MACH-105183]

**Responsible:** Dr. Mazin Jouda, Prof. Dr. Jan Gerrit Korvink

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102616 - Major Field: Microsystem Technology
- M-MACH-102647 - Major Field: Microactuators and Microsystems
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
- M-MACH-102742 - Fundamentals and Methods of Production Technology

**Type:** Written examination

**Credits:** 4

**Grading scale:** Grade to a third

**Recurrence:** Each summer term

**Version:** 1

**Events**

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**Exams**

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<td>76-T-MACH-105183</td>
<td>2 SWS</td>
<td>Lecture / 🖥</td>
<td>Korvink, Badilita</td>
</tr>
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</table>

**Competence Certificate**

Written examination (60 min)

**Prerequisites**

None

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

**Introduction to Microsystem Technology II**

2142874, SS 2021, 2 SWS, Language: English, [Open in study portal](#)

**Content**

- Introduction in Nano- and Microtechnologies
- Lithography
- LIGA-technique
- Mechanical microfabrication
- Patterning with lasers
- Assembly and packaging
- Microsystems

**Organizational issues**

**Topic:** Grundlagen der Mikrosystemtechnik II (MST II) SS 21

**Time:** Thursdays 14:00 - 15:30

Join Zoom Meeting

https://kit-lecture.zoom.us/j/66193228123?pwd=eEpTTFJoNzY5ZktRMG5GTEg3bExmdz09

Meeting ID: 661 9322 8123

Passcode: 424794

**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
10.226 Course: Introduction to Neutron Cross Section Theory and Nuclear Data Generation [T-MACH-105466]

**Responsible:** apl. Prof. Dr. Ron Dagan

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102608 - Major Field: Nuclear Energy

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

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<td>2 SWS</td>
<td>Lecture / 🔄</td>
<td>Dagan</td>
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**Exams**

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<td>ST 2021</td>
<td>2 SWS</td>
<td>Lecture / 🔄</td>
<td>Dagan</td>
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<tr>
<td>WT 21/22</td>
<td>2 SWS</td>
<td>Lecture / 🔄</td>
<td>Dagan</td>
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</tbody>
</table>

**Competence Certificate**

oral exam of about 30 minutes

**Prerequisites**

none

**Annotation**

none

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

**Introduction to Neutron Cross Section Theory and Nuclear Data Generation**

2190490, SS 2021, 2 SWS, Language: German/English, Open in study portal

**Content**

- Cross section characterization
- Summary of basic cross section theory
- Resonance cross section
- Doppler broadening
- Scattering kernels
- Basic of slowing down theory
- Unit cell based XS data generation
- Cross sections Data libraries
- Data Measurements

The students:

- Understand the special importance of cross sections in various domains of natural science (Reactor physics, Material research, Solar radiation etc.)
- Are familiar with the theoretical methods and experimental effort to generate cross sections data.

Regular attendance: 26 h

self study: 94 h

oral exam about 30 min.
Literature
Handbuch von Nuklearen Reaktoren Vol I . Y. Ronen CRC press 1986 (in English)
P. Tippler, R. Llewellyn Modern Physics 2008 (in English)
10.227 Course: Introduction to Nonlinear Vibrations [T-MACH-105439]

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

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102646 - Major Field: Applied Mechanics
- M-MACH-104443 - Major Field: Vibration Theory

Type: Oral examination
Credits: 7
Grading scale: Grade to a third
Recurrence: Each winter term
Version: 1

Events

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<th>Introduction to Nonlinear Vibrations</th>
<th>2 SWS</th>
<th>Lecture / 🛰</th>
<th>Fidlin</th>
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<tbody>
<tr>
<td>WT 21/22</td>
<td>2162248</td>
<td>Introduction into the nonlinear vibrations (Tutorial)</td>
<td>2 SWS</td>
<td>Practice</td>
<td>Fidlin, Yüzbasioglu</td>
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</table>

Exams

| ST 2021 | 76-T-MACH-105439 | Introduction to Nonlinear Vibrations | Fidlin |

Competence Certificate
oral exam, 30 min.

Prerequisites
none

Recommendation
Vibration theory, Mathematical Methods of Vibration Theory, Dynamic Stability

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

**Introduction to Nonlinear Vibrations**
2162247, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

Content

- dynamic systems
- basic ideas of asymptotic methods
- perturbation methods: Linstedt-Poincare, averaging, multiple scales
- limit cycles
- nonlinear resonance
- basics of the bifurcation analysis, bifurcation diagrams
- types of bifurcations
- discontinuous systems
- dynamic chaos
Literature


Introduction into the nonlinear vibrations (Tutorial)
2162248, WS 21/22, 2 SWS, Language: German, Open in study portal

Content
Exercises related to the lecture
# Course: Introduction to Nuclear Energy [T-MACH-105525]

**Responsible:** Prof. Dr.-Ing. Xu Cheng  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102608 - Major Field: Nuclear Energy  
- M-MACH-102610 - Major Field: Power Plant Technology  
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology

<table>
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## Events

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<th>Introduction to Nuclear Energy</th>
<th>2 SWS</th>
<th>Lecture / 🖥</th>
<th>Cheng</th>
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</table>

| Exams | 76-T-MACH-105525 | Introduction to Nuclear Energy | Cheng |

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

### Competence Certificate

oral exam, 30 min

### Prerequisites

none

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

**Introduction to Nuclear Energy**  
2189903, WS 21/22, 2 SWS, Language: German, Open in study portal  
Lecture (V) Online

### 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.
Course: Introduction to Numerical Fluid Dynamics [T-MACH-105515]

Responsible: Dr. Balazs Pritz
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102627 - Major Field: Energy Converting Engines

Type Completed coursework
Credits 4
Grading scale pass/fail
Recurrence Each winter term
Version 1

Events

<table>
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Exams

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

Competence Certificate
Certificate of participation

Prerequisites
none

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

Introduction to numerical fluid dynamics

2157444, WS 21/22, 2 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
The lab gives an overview of the application of computational fluid dynamics (CFD). At the end of the course the students will be able to perform CFD calculations independently.

In the lab, the components of the cycle of computational fluid dynamics are worked through. In the first instance moderately complicated geometries will be generated and meshed. After the configuration and running the calculation, the results are presented and evaluated in a visualization software. While in the first part of the course these steps are worked out under guidance, calculation cycles are carried out independently in the second part. The test cases are discussed in detail and allow to strengthen the affinity to the fluid dynamics.

Content:
1. Brief introduction into Linux
2. Mesh generation with ICEMCFD
3. Data visualisation and interpretation with Tecplot
4. Handling of the flow solver SPARC
5. Self-designed calculation: flat plate
6. Introduction to unsteady calculations: flow around a circular cylinder

Regular attendance: 22,5 hours
Self-study: 97,5 hours
Lecture notes/handouts are offered.

Learning objectives:

Students
- know the three components of CFD: mesh generation, calculation and evaluation.
- will be able to create simple geometries and generate mesh.
- can set up and carry out simulations.
- know the ways of evaluating the results and the possibilities of flow visualization.
- know how to analyze flow situations.
Literature
Praktikumsskript
10.230 Course: Introduction to numerical mechanics [T-MACH-108718]

**Responsible:** Prof. Dr. Eckart Schnack

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

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<td>Recurrence</td>
<td>Each winter term</td>
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<td>Version</td>
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**Competence Certificate**

Oral Exam, 20 minutes

**Prerequisites**

None

**Annotation**

The lecture notes are made available via ILIAS.
### 10.231 Course: Introduction to Rheology [T-CHEMBIO-100303]

**Organisation:** KIT Department of Chemistry and Biosciences  
**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

<table>
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<td>Introduction to Rheology</td>
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<td>Introduction to Rheology</td>
<td>Wilhelm</td>
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</table>
10.232 Course: Introduction to the Finite Element Method [T-MACH-105320]

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

Organisation: KIT Department of Mechanical Engineering

Part of:  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102628 - Major Field: Lightweight Construction

Events

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Exams

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<tr>
<td>ST 2021 76-T-MACH-105320 Introduction to the Finite Element Method</td>
<td></td>
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</table>

Competence Certificate  
written exam (90 min)

prerequisites: passing the corresponding "Tutorial to Introduction to the Finite element method" (T-MACH-110330)

Prerequisites  
Passing the "Tutorial to Introduction to the Finite element method" (T-MACH-110330) is a prerequisite for taking part in the exam.

Modeled Conditions  
The following conditions have to be fulfilled:

1. The course T-MACH-110330 - Tutorial Introduction to the Finite Element Method must have been passed.

Annotation

Knowledge of the contents of the courses "Continuum Mechanics of Solids and Fluids" and "Mathematical Methods of Continuum Mechanics" as well as the corresponding tutorials are expected

Due to capacity reasons it is possible that not all students of this course can be admitted to the computer tutorials. Students of the bachelor's degree program in mechanical engineering who have chosen the Major Field Continuum Mechanics (SP-Nr 13) will be admitted to the computer tutorials in any case. If additional places are available in the computer tutorials for this course, these will be allocated according to the BSc average grade.

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

Introduction to the Finite Element Method

2162282, SS 2021, 2 SWS, Language: German, Open in study portal

Content

- introduction and motivation, elements of tensor calculus
- Discrete FEM: systems of bars and springs
- Formulations of boundary value problems (1D)
- Approximations in FEM
- FEM for scalar and vector-valued field problems
- Solution methods for linear systems of equations
Literature

- Fish, J., Belytschko, T.: A First Course in Finite Elements, Wiley 2007
10.233 Course: Introduction to Theory of Materials [T-MACH-105321]

**Responsible:** apl. Prof. Marc Kamlah  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering  
M-MACH-102646 - Major Field: Applied Mechanics  
M-MACH-102647 - Major Field: Microactuators and Microsensors

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**Events**

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**Exams**

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

**Competence Certificate**

oral exam

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

![V] Introduction to Theory of Materials  
2182732, SS 2021, 2 SWS, Language: German, Open in study portal  
Lecture (V) Cancelled

**Content**

Following a brief introduction into continuum mechanics at small deformations, the classification into elastic, viscoelastic, plastic and viscoplastic constitutive models of solids is discussed. Then, one after the other, the four groups of elastic, viscoelastic, plastic and viscoplastic constitutive models are motivated and mathematically formulated. Their properties are demonstrated by means of elementary analytical solutions and examples.

The student can judge for a problem to be computed, which constitutive model should be selected depending on choice of material and loading. For computation tools such as commercial finite element codes, the students can understand the documentation with respect to the implemented constitutive models, and they can make their choice based on their knowledge. The students have basic knowledge for the development of constitutive laws.

Qualification: Engineering Mechanics; Advanced Mathematics

regular attendance: 22.5 hours  
self-study: 97.5 hours  
oral exam ca. 30 minutes

**Literature**

[2] Skript
10.234 Course: IoT Platform for Engineering [T-MACH-106743]

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

**Part of:** M-MACH-102613 - Major Field: Lifecycle Engineering

<table>
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**Exams**

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<td>Project (P / 🧩)</td>
<td>Each term</td>
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<td>IoT platform for engineering</td>
<td>3 SWS</td>
<td>/ 🧩</td>
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</tr>
</tbody>
</table>

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

**Competence Certificate**
Assessment of another type (graded), procedure see webpage. Number of participants limited to 20 people. There is a participant selection process.

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

**IoT platform for engineering**

2123352, SS 2021, 3 SWS, Language: German, [Open in study portal](#)

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

**Content**

Industry 4.0, IT systems for fabrication and assembly, process modelling and execution, project work in teams, practice-relevant I4.0 problems, in automation, manufacturing industry and service.

Students can

- map and analyze processes in the context of Industry 4.0 with special methods of process modelling
- collaboratively grasp practical I4.0 issues using existing hardware and software and work out solutions for a continuous improvement process in a team
- prototypically implement the self-developed solution proposal with the given IT systems and the existing hardware equipment and finally present the results

**Organizational issues**

Siehe Homepage zur Lehrveranstaltung

**Literature**

Keine / None

**IoT platform for engineering**

2123352, WS 21/22, 3 SWS, Language: German, [Open in study portal](#)

*Blended (On-Site/Online)*

**Content**

Industry 4.0, IT systems for fabrication and assembly, process modelling and execution, project work in teams, practice-relevant I4.0 problems, in automation, manufacturing industry and service.

Students can

- map and analyze processes in the context of Industry 4.0 with special methods of process modelling
- collaboratively grasp practical I4.0 issues using existing hardware and software and work out solutions for a continuous improvement process in a team
- prototypically implement the self-developed solution proposal with the given IT systems and the existing hardware equipment and finally present the results

**Literature**

Keine / None
10.235 Course: IT-Fundamentals of Logistics [T-MACH-105187]

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

Part of:
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102599 - Major Field: Powertrain Systems
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102624 - Major Field: Information Technology
- M-MACH-102625 - Major Field: Information Technology of Logistic Systems
- M-MACH-102640 - Major Field: Technical Logistics

Type
- Oral examination

Credits
- 4

Grading scale
- Grade to a third

Recurrence
- Each summer term

Version
- 3

Events

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<td>IT-Fundamentals of Logistics: Opportunities for Digital Transformation</td>
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Exams

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<td>IT-Fundamentals of Logistics</td>
<td>Furmans, Mittwollen, Thomas</td>
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</table>

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

Competence Certificate

The success control takes place in form of a written examination during the semester break (according to §4(2), 1 SPO). If the number of participants is low, an oral examination (according to §4 (2), 2 SPO) may also be offered.

Prerequisites

none

Annotation

1) Detailed script can be downloaded online (www.tup.com), updated and enhanced annually.
2) CD-ROM with chapters and exercises at the end of the semester available from the lecturer, also updated and enhanced annually.

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

IT-Fundamentals of Logistics: Opportunities for Digital Transformation
- Lecture (V)
- Blended (On-Site/Online)

2118184, SS 2021, 2 SWS, Language: German, Open in study portal
### 10.236 Course: Lab Computer-Aided Methods for Measurement and Control [T-MACH-105341]

**Responsible:** Prof. Dr.-Ing. Christoph Stiller  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102598 - Major Field: Advanced Mechatronics  
- M-MACH-102601 - Major Field: Automation Technology  
- M-MACH-102609 - Major Field: Cognitive Technical Systems  
- M-MACH-102624 - Major Field: Information Technology  
- M-MACH-102633 - Major Field: Robotics

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

**Competence Certificate**  
Colloquia

**Prerequisites**  
none

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

**Lab Computer-aided methods for measurement and control**  
2137306, WS 21/22, 3 SWS, Language: German, Open in study portal  
Practical course (P)  
On-Site
Content
Lerninhalt (EN):
1. Digital technology
2. Digital storage oscilloscope and digital spectrum analyzer
3. Supersonic computer tomography
4. Lighting and image acquisition
5. Digital image processing
6. Image interpretation
7. Control synthesis and simulation
8. Robot: Sensors
9. Robot: Actuating elements and path planning
The lab comprises 9 experiments.

Voraussetzungen: Recommendations:
Basic studies and preliminary examination; basic lectures in automatic control

Arbeitsaufwand (EN): 120 hours

Lernziele (EN):
Powerful and cheap computation resources have led to major changes in the domain of measurement and control. Engineers in various fields are nowadays confronted with the application of computer-aided methods. This lab tries to give an insight into the modern domain of measurement and control by means of practically oriented and flexible experiments. Based on experiments on measurement instrumentation and digital signal processing, elementary knowledge in the domain of visual inspection and image processing will be taught. Thereby, commonly used software like MATLAB/Simulink will be used in both simulation and realization of control loops. The lab closes with selected applications, like control of a robot or supersonic computer tomography.

Nachweis (EN):
Colloquia

Literature
Übungsanleitungen sind auf der Institutshomepage erhältlich.
Instructions to the experiments are available on the institute's website
10.237 Course: Lab Course Experimental Solid Mechanics [T-MACH-105343]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102591 - Laboratory Course

<table>
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**Events**

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<th>Lab course experimental solid mechanics</th>
<th>3 SWS</th>
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<th>Böhlke</th>
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</thead>
</table>

| ST 2021 | 76-T-MACH-105343 | Lab Course Experimental Solid Mechanics | Böhlke |

**Exams**

**Competence Certificate passed / not passed**

Each participant has to hand in six lab course report (eon for each day of lab course), which will be evaluated. At the end of the lab course, the participants have to give a colloquium (approx 20 min) about a given topic of the experiments done.

**Prerequisites**

none

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

**Lab course experimental solid mechanics**

2162275, SS 2021, 3 SWS, Language: German, Open in study portal

**Content**

Anisotropic materials; Experiments for determination of the five material constants of thermoelasticity; Experiments for determination of parameters of the inelastic material behaviour

**Organizational issues**

im SS 21 als Blockveranstaltung geplant; weitere Informationen auf unsere Webseite

**Literature**

wird im Praktikum angegeben
10.238 Course: Laboratory Exercise in Energy Technology [T-MACH-105331]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
Prof. Dr. Ulrich Maas  
Dr.-Ing. Heinrich Wirbser

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102591 - Laboratory Course  
M-MACH-102610 - Major Field: Power Plant Technology  
M-MACH-102623 - Major Field: Fundamentals of Energy Technology

<table>
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**Events**

| ST 2021 | 2171487 | Laboratory Exercise in Energy Technology | 3 SWS | Practical course / Bauer, Maas, Bykov |
| WT 21/22 | 2171487 | Laboratory Exercise in Energy Technology | 3 SWS | Practical course / Bauer, Maas, Bykov |

**Exams**

| ST 2021 | 76-T-MACH-105331 | Laboratory Exercise in Energy Technology | Bauer, Maas, Wirbser |
| WT 21/22 | 76-T-MACH-105331 | Laboratory Exercise in Energy Technology | Bauer, Maas, Wirbser |

**Competition Certificate**

1 report, approx. 12 pages  
Discussion of the documented results with the assistents

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*
Content
Online registration within the first two weeks of the lecture period at: http://www.its.kit.edu

- Micro gas turbine
- Several test rigs for the investigation of heat transfer at thermally high loaded components
- Optimization of components of the internal air and oil system
- Characterization of spray nozzles
- Investigation of pollutant and noise emission as well as reliability and material deterioration
- Exhaust gas treatment
- Exhaust gas turbocharger
- Cooling Tower
- Heatpump
- Plant oil stove
- Heat capacity
- Wood combustion

regular attendance: 42h
self-study: 78h

Attending this course enables the students to:

- accomplish experimental and design related as well as theoretical tasks in a scientific background
- perform a correct evaluation of the obtained results
- adequately document and present their results in a scientific framework

1 report, approx. 12 pages
Discussion of the documented results with the assistants

Duration: 30 minutes

no tools or reference materials may be used

Organizational issues
Information zum Lehrlabor finden Sie auf der Instituts-homepage

Laboratory Exercise in Energy Technology
2171487, WS 21/22, 3 SWS, Language: German/English, Open in study portal
Content
Online registration within the first two weeks of the lecture period at: http://www.its.kit.edu

- Micro gas turbine
- Several test rigs for the investigation of heat transfer at thermally high loaded components
- Optimization of components of the internal air and oil system
- Characterization of spray nozzles
- Investigation of pollutant and noise emission as well as reliability and material deterioration
- Exhaust gas treatment
  - Exhaust gas turbocharger
  - Cooling Tower
  - Heatpump
  - Plant oil stove
  - Heat capacity
  - Wood combustion

regular attendance: 42h
self-study: 78h

Attending this course enables the students to:

- accomplish experimental and design related as well as theoretical tasks in a scientific background
- perform a correct evaluation of the obtained results
- adequately document and present their results in a scientific framework

1 report, approx. 12 pages
Discussion of the documented results with the assistants

Duration: 30 minutes

no tools or reference materials may be used

Organizational issues
Praktika finden in Präsenz statt, sofern die COVID-Inzidenzwerte es zulassen.
### 10.239 Course: Laboratory Laser Materials Processing [T-MACH-102154]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102591 - Laboratory Course
- M-MACH-102611 - Major Field: Materials Science and Engineering
- M-MACH-102618 - Major Field: Production Technology

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<td>Laboratory &quot;Laser Materials Processing&quot;</td>
<td>3 SWS</td>
<td>Practical course / 🧩 Schneider, Pfleging</td>
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<td>Laboratory Laser Materials Processing</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**
The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

**Prerequisites**
None

**Recommendation**
Basic knowledge of physics, chemistry and material science is assumed.

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

### Laboratory "Laser Materials Processing"

2183640, SS 2021, 3 SWS, Language: German, Open in study portal
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
Bereits ausgebucht!

Anmeldung per Email an johannes.schneider@kit.edu

Das Praktikum findet in Kleingruppen am IAM-CMS (CS) bzw. IAM-AWP (CN) statt!

Die Termine werden zu Beginn des Semesters bekannt gegeben.

Literature
R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer
Content
The laboratory compromises 8 half-day experiments, which address the following laser processing topics of metals, ceramics and polymers:

- safety aspects
- surface hardening and remelting
- melt and reactive cutting
- surface modification by dispersing or alloying
- welding
- surface texturing
- metrology

There are used CO2-, excimer-, Nd:YAG- and high power diode-laser sources within the laboratory.

The student

- can describe the influence of laser, material and process parameters and can choose suitable parameters for the most important methods of laser-based processing in automotive engineering.
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

The attendance to one of the courses Physical Basics of Laser Technology (2181612) or Laser Application in Automotive Engineering (2182642) is strongly recommended.

regular attendance: 34 hours
self-study: 86 hours

The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Organizational issues
Maximal 12 Teilnehmer/innen!
Aktuell sind bereist alle Plätze vergeben! Registrierung für Nachrückliste möglich per Email an johannes.schneider@kit.edu
Praktikum findet in Kleingruppen semesterbegleitend (dienstags bzw. mittwochs, ganztägig) bzw. als Blockpraktikum 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
R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer
10.240 Course: Laboratory Mechatronics [T-MACH-105370]

**Responsible:** Prof. Dr. Veit Hagenmeyer
Prof. Dr.-Ing. Wolfgang Seemann
Prof. Dr.-Ing. Christoph Stiller

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102591 - Laboratory Course
- M-MACH-102605 - Major Field: Engineering Design
- M-MACH-102609 - Major Field: Cognitive Technical Systems
- M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

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

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<td>3 SWS</td>
<td>pass/fail</td>
<td>Each winter term</td>
<td>Seemann, Stiller, Böhland, Chen, Burgert, Bitner</td>
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**Competition Certificate**
The laboratory course is offered exclusively as ungraded course work. The assessment consists of a group colloquium at the beginning of the individual specialization phases (Part 1). In addition, a robot control system for a pick-and-place task must be successfully implemented in the group phase (Part 2).

**Prerequisites**
None

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

**Laboratory mechatronics**

2105014, WS 21/22, 3 SWS, Language: German, Open in study portal

**Practical course (P)**
On-Site

**Content**

**Part I**
- Control, programming and simulation of robots
- CAN-Bus communication
- Image processing / machine vision
- Dynamic simulation of robots in ADAMS

**Part II**
Solution of a complex problem in team work

**Learning objectives:**
The student is able to ...

- use his knowledge about mechatronics and microsystems technology to solve a practical problem. The laboratory course comprises simulation, bus communication, measurement instrumentation, control engineering and programming.
- integrate the different subsystems from a manipulator to a working compound system in teamwork.

Nachweis (EN): certificate of successful attendance
Voraussetzung (EN): none
Arbeitsaufwand (EN):
- regular attendance: 33.5 h
- self-study: 88.5 h
Organizational issues
Das Praktikum ist anmeldepflichtig.
Die Anmeldungsmodalitäten-/fristen werden auf https://www.iai.kit.edu/Pruefungen.php bekannt gegeben.
Siehe Internet / Aushang Raum 033 EG, im Gebäude 40.32.

Literature
Materialien zum Mechatronik-Praktikum
Manuals for the laboratory course on Mechatronics
10.241 Course: Laboratory Production Metrology [T-MACH-108878]

Responsible: Dr.-Ing. Benjamin Häfner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102618 - Major Field: Production Technology
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102633 - Major Field: Robotics

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Events

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<td>ST 2021</td>
<td>76-T-MACH-108878</td>
<td>Laboratory Production Metrology</td>
<td>Häfner</td>
<td></td>
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</table>

Exams

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

Competence Certificate

Alternative Test Achievement: Group presentation of 15 min at the beginning of each experiment and evaluation of the participation during the experiments and Oral Exam (15 min)

Prerequisites

none

Annotation

For organizational reasons the number of participants for the course is limited. Hence a selection process will take place. Applications are made via the homepage of wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

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

Laboratory Production Metrology

2150550, SS 2021, 3 SWS, Language: German, Open in study portal

Practical course (P) On-Site
Content
During this course, students get to know measurement systems that are used in a production system. In the age of Industry 4.0, sensors are becoming more important. Therefore, the application of in-line measurement technology such as machine vision and non-destructive testing is focussed. Additionally, laboratory based measurement technologies such as computed tomography are addressed. The students learn the theoretical background as well as practical applications for industrial examples. The students use sensors by themselves during the course. Additionally, they are trained on how to integrate sensors in production processes and how to analyze measurement data with suitable software.

The following topics are addressed:

- Classification and examples for different measurement technologies in a production environment
- Machine vision with optical sensors
- Information fusion based on optical measurements
- Robot-based optical measurements
- Non-destructive testing by means of acoustic measurements
- Coordinate measurement technology
- Industrial computed tomography
- Measurement uncertainty evaluation
- Analysis of production data by means of data mining

Learning Outcomes:
The students …

- are able to name, describe and mark out different measurement technologies that are relevant in a production environment.
- are able to conduct measurements with the presented in-line and laboratory based measurement systems.
- are able to analyze measurement results and assess the measurement uncertainty of these.
- are able to deduce whether a work piece fulfills quality relevant specifications by analysing measurement results.
- are able to use the presented measurement technologies for a new task.

Workload:
regular attendance: 31,5 hours
self-study: 88,5 hours

Organizational issues
Die Lehrveranstaltung findet stets dienstags nachmittags statt.


The course always takes place on Tuesdays in the afternoon.

For organizational reasons the number of participants for the course is limited. Hence al selection process will take place. Applications are made via the homepage of wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

Literature

Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/). Additional reference to literature will be provided, as well.
10.242 Course: Laser in Automotive Engineering [T-MACH-105164]

**Responsible:** Dr.-Ing. Johannes Schneider  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102607 - Major Field: Vehicle Technology  
- M-MACH-102611 - Major Field: Materials Science and Engineering  
- M-MACH-102628 - Major Field: Lightweight Construction

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

**Events**

| ST 2021 | 2182642 | Laser in automotive engineering | 2 SWS | Lecture / Online | Schneider |

**Exams**

| WT 21/22 | 76-T-MACH-105164 | Laser in Automotive Engineering | Schneider |

**Legend:**  
- 📱 Online  
- 🧩 Blended (On-Site/Online)  
- 🗣 On-Site  
- ❌ Cancelled

**Competence Certificate**

oral examination (30 min)

no tools or reference materials

**Prerequisites**

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

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-102102 - Physical Basics of Laser Technology must not have been started.
2. The course T-MACH-109084 - Physical Basics of Laser Technology must not have been started.

**Recommendation**

preliminary knowledge in mathematics, physics and materials science

**Below you will find excerpts from events related to this course:**

Laser in automotive engineering  
2182642, SS 2021, 2 SWS, Language: German, Open in study portal
Content
Based on a short description of the physical basics of laser technology the lecture reviews the most important high power lasers and their various applications in automotive engineering. Furthermore the application of laser light in metrology and safety aspects will be addressed.

- physical basics of laser technology
- laser beam sources (Nd:YAG-, CO2-, high power diode-laser)
- beam properties, guiding and shaping
- basics of materials processing with lasers
- laser applications in automotive engineering
- economical aspects
- safety aspects

The student
- can explain the principles of light generation, the conditions for light amplification as well as the basic structure and function of Nd:YAG-, CO2- and high power diode-laser sources.
- can describe the most important methods of laser-based processing in automotive engineering and illustrate the influence of laser, material and process parameters
- can analyse manufacturing problems and is able to choose a suitable laser source and process parameters.
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.
It is not possible, to combine this lecture with the lecture Physical basics of laser technology [2181612].

regular attendance: 22.5 hours
self-study: 97.5 hours
oral examination (ca. 30 min)

no tools or reference materials

Organizational issues
Bitte nutzen Sie die Vorlesungsaufzeichnung aus dem SS 19!
Bei Interesse bitte melden bei johannes.schneider@kit.edu!
Aktuelle Infos werden über ILIAS verteilt!

Literature
R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer
10.243 Course: Leadership and Conflict Management [T-MACH-105440]

**Responsible:** Hans Hatzl  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102596 - Compulsory Elective Subject Economics/Law  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102600 - Major Field: Man - Technology - Organisation  
M-MACH-102605 - Major Field: Engineering Design

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**Events**

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<th>2110017</th>
<th>Leadership and Conflict Management (in German)</th>
<th>2 SWS</th>
<th>Lecture / 🗹</th>
<th>Hatzl</th>
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**Exams**

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<th>76-T-MACH-105440</th>
<th>Leadership and Conflict Management</th>
<th>Deml, Hatzl</th>
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</thead>
</table>

**Legend:**  
🖥 Online, 🧩 Blended (On-Site/Online), 🗹 On-Site, 🗹 Cancelled

**Competence Certificate**

oral exam (approx. 30 min)

**Prerequisites**

none

**Annotation**

This lecture will also be offered once in winter term 20/21.

---

**Below you will find excerpts from events related to this course:**

**Leadership and Conflict Management (in German)**

2110017, SS 2021, 2 SWS, Language: German, [Open in study portal](#)  

**Lecture (V)**

Cancelled

---

**Content**

In this compact event, management and leadership techniques are taught which are among the key qualifications for management tasks. Furthermore, you will be prepared for management and leadership tasks.

The course consists of the following course contents:

1. Introduction to the topic  
   - Goal setting and goal achievement  
   - Management techniques in planning  
   - Communication and information  
   - Decision Theory  
   - Leadership and cooperation  
   - Self Management  
   - Conflict management and strategy  
   - Case studies

It passes:

- Obligatory attendance

recommendations:

- Knowledge of work and economic science is advantageous

**Organizational issues**

Da das ganze Sommersemester 2021 komplett digital stattfinden soll, muss diese Präsenzveranstaltung leider abgesagt werden.


**Literature**

Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.
10.244 Course: Leadership and Management Development [T-MACH-105231]

Responsible: Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Sven Matthiesen  
Andreas Ploch

Organisation: KIT Department of Mechanical Engineering

Part of:  
M-MACH-102596 - Compulsory Elective Subject Economics/Law  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102599 - Major Field: Powertrain Systems  
M-MACH-102600 - Major Field: Man - Technology - Organisation  
M-MACH-102605 - Major Field: Engineering Design  
M-MACH-102618 - Major Field: Production Technology  
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

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Events

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<tr>
<td>WT 21/22</td>
<td>2145184</td>
<td>Leadership and Product Development</td>
<td>2 SWS</td>
<td>Lecture</td>
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</table>

Competence Certificate
oral exam (20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

Leadership and Product Development

2145184, WS 21/22, 2 SWS, Language: German, Open in study portal

Content
Overview of leadership theories and their application
Selected management instruments and their use in organizations
Communication and leadership
change management
Management development and MD programmes
Assessment centres and management audits
Teamwork, team development and team roles
Coaching as an instrument of modern leadership
Intercultural competence and cross-cultural leadership
Management and ethics, corporate governance
Practical exercises and examples to deepen selected contents

Organizational issues
Vorlesungsanmeldung und Informationen zur Veranstaltung werden im ILIAS Kurs zur Verfügung gestellt.
Weitere Information siehe IPEK-Homepage

Literature
Vorlesungsumdruck
10.245 Course: Learning Factory “Global Production“ [T-MACH-105783]

**Responsible:** Prof. Dr.-Ing. Gisela Lanza  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102618 - Major Field: Production Technology

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<td>Learning Factory “Global Production”</td>
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### Competence Certificate

**Alternative test achievement (graded):**

- Knowledge acquisition in the context of the seminar (4 achievements 20 min each) with weighting 40%.
- Interaction between participants with weighting 15%.
- Scientific colloquium (in groups of 3 students approx. 45 min each) with weighting 45%.

### Prerequisites

none

### Annotation

For organisational reasons, the number of participants for the course is limited to 20. As a result, a selection process will take place. Applications must be submitted via the wbk homepage ([http://www.wbk.kit.edu/lernfabrik.php](http://www.wbk.kit.edu/lernfabrik.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

**Below you will find excerpts from events related to this course:**
Content
The learning factory "Global Production" serves as a modern teaching environment for the challenges of global production. To make this challenges come alive, students can run a production of electric motors under real production conditions. The course is divided into e-learning units and presence dates. The e-learning units help to learn essential basics and to immerse themselves in specific topics (e.g. selection of location, supplier selection and planning of production networks). The focus of the presence appointments is the case-specific application of relevant methods for planning and control of production systems that are suitable for the location. In addition to traditional methods and tools to organize lean production systems (e.g. Kanban and JIT/ JIS, Line Balancing) the lecture in particular deals with site-specific quality assurance and scalable automation. Essential methods for quality assurance in complex production systems are taught and brought to practical experience by a Six Sigma project. In the area of scalable automation, it is important to find solutions for the adaption of the level of automation of the production system to the local production conditions (e.g. automated workpiece transport, integration of lightweight robots for process linking) and to implement them physically. At the same time safety concepts should be developed and implemented as enablers for human-robot collaboration.

The course also includes an excursion to the production plant for the manufacturing of electric motors of an industrial partner.

Main focus of the lecture:

- site selection
- site-specific factory planning
- site-specific quality assurance
- scalable automation
- supplier selection

Learning Outcomes:
The students are able to …

- evaluate and select alternative locations using appropriate methods.
- use methods and tools of lean management to plan and manage production systems that are suitable for the location.
- use the Six Sigma method and apply goal-oriented process management.
- select an appropriate level of automation of the production units based on quantitative variables.
- make use of well-established methods for the evaluation and selection of suppliers.
- apply methods for planning a global production network depending on company-specific circumstances to sketch a suitable network and classify and evaluating it according to specific criteria.
- apply the learned methods and approaches with regard to problem solving in a global production environment and able to reflect their effectiveness.

Workload:
e-Learning: ~ 24 h
regular attendance: ~ 36 h
self-study: ~ 60 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

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

Literature

Medien:

Media:
E-learning platform ilias, powerpoint, photo protocol. The media are provided through ilias (https://ilias.studium.kit.edu/).
10.246 Course: Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice [T-MACH-110954]

Responsible: Dr.-Ing. Luise Kärger
Dr.-Ing. Wilfried Liebig

Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-102611 - Major Field: Materials Science and Engineering
- M-MACH-102613 - Major Field: Lifecycle Engineering
- M-MACH-102618 - Major Field: Production Technology
- M-MACH-102628 - Major Field: Lightweight Construction
- M-MACH-102632 - Major Field: Polymer Engineering

Type
Oral examination

Credits
4

Grading scale
Grade to a third

Recurrence
Each winter term

Version
1

Events

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<td>Each winter term</td>
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Events

WT 21/22 2113110 Lightweight constructions with fiber-reinforced-polymers – theory and practice 4 SWS Lecture / Practice ( / 🗣 Kärger, Liebig

Legend: 🖥 Online, 🍀 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate
oral exam (about 25 minutes)

Prerequisites
none

Recommendation
- Materials of Lightweight Construction
- Structural Analysis of Composite Laminates
- Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies

Below you will find excerpts from events related to this course:

Lightweight constructions with fiber-reinforced-polymers – theory and practice
2113110, WS 21/22, 4 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site
Content
The cooperative educational concept of the FAST-LBT and IAM-WK give students an understanding of theory and practice for lightweight constructing with fiber-reinforced-polymers. Students solve an engineering lightweight task in small groups (max. 4 p.), for example the construction of an optimal bending beam under certain space and weight conditions. Various Materials (fibers, resins, foams, etc.) as well as relevant material data are provided and can be used any arbitrary combination. In a first step, students develop a theoretical solution and verify it simulative. Therefore, an introductory basic lecture teaches the mechanics and simulations techniques of fiber-reinforced-polymers. In a second step the students manufacture specimens based on their theoretical solution at the IAM-WK. The specimens are then tested on bending machines. The students gain knowledge about fiber-reinforced-polymers (materials, manufacturing, manufacturing effects, restrictions, etc.) and structural analysis simulations (modelling, simplifications, assumptions, material models, etc.) as well as material characterization and testing. Building on the basic lecture the knowledge is gained autonomously by solving realistic practice relevant tasks. The main topics are:

- Basics of Lightweight strategies
- Basics of fiber-reinforced-polymers
- Basics of FEM-simulations with anisotropic material systems
- Simulative part analysis
- Manufacturing of fiber-reinforced-polymers
- Mechanical testing

Learning Objectives: Students will be able to name and explain lightweight design strategies. They are familiar with typical fiber and matrix materials and their function in fiber composite materials. They will be familiar with the operating principle of a sandwich composite with foam core and will be able to describe and justify typical deformation and stress curves. They can name characteristic mechanical parameters and manufacturing processes. For the numerical analysis of FRP components, the students know simple laminate theories, they can set up a finite element model in Abaqus, select suitable finite elements, evaluate the simulation results and derive conclusions for improving the load-bearing effect. Students know the main steps and boundary conditions for manual fabrication and mechanical testing of fiber composite sandwich structures and can apply them in practice.

Organizational issues
Die Veranstaltung findet Mittwochs von 14:00 - 17:00 Uhr statt - Die Raumbelegung wird zu Beginn des Wintersemesters bekannt gegeben
10.247 Course: Lightweight Engineering Design [T-MACH-105221]

**Responsible:** Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Norbert Burkardt

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102598 - Major Field: Advanced Mechatronics  
- M-MACH-102605 - Major Field: Engineering Design  
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics  
- M-MACH-102607 - Major Field: Vehicle Technology  
- M-MACH-102615 - Major Field: Medical Technology  
- M-MACH-102628 - Major Field: Lightweight Construction  
- M-MACH-102633 - Major Field: Robotics  
- M-MACH-102636 - Major Field: Thermal Turbomachines  
- M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

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<td>Each summer term</td>
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**Events**

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<th>ST 2021</th>
<th>2146190</th>
<th>Lightweight Engineering Design</th>
<th>2 SWS</th>
<th>Lecture / 🖥</th>
<th>Albers, Burkardt</th>
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**Exams**

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<th>76-T-MACH-105221</th>
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<td>WT 21/22</td>
<td>76-T-MACH-105221</td>
<td>Lightweight Engineering Design</td>
<td>Albers, Burkardt</td>
</tr>
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</table>

**Competence Certificate**

Written examination (90 min)

**Prerequisites**

None

**Below you will find excerpts from events related to this course:**

**Lightweight Engineering Design**

2146190, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Content**

General aspects of lightweight design, lightweight strategies, construction methods, design principles, lightweight construction, stiffening techniques, lightweight materials, virtual product engineering, bionics, joining techniques, validation, recycling

Additionally, guest speakers from industry will present lightweight design from an practical point of view.

The students are able to ...

- evaluate the potential of central lightweight strategies and their application in design processes.
- apply different stiffing methods qualitatively and to evaluate their effectiveness.
- evaluate the potential of computer-aided engineering as well as the related limits and influences on manufacturing.
- reflect the basics of lightweight construction from a system view in the context of the product engineering process.
Organizational issues
Vorlesungsfolien können über die eLearning-Plattform ILIAS bezogen werden.
Die Prüfungsart wird gemäß der Prüfungsordnung zu Vorlesungsbeginn angekündigt:

- Schriftliche Prüfung: 90 min Prüfungsdauer
- Mündliche Prüfung: 20 min Prüfungsdauer
- Erlaubte Hilfsmittel: keine

Medien: Beamer

Arbeitsbelastung:

- Präsenzzeit: 21 h
- Selbststudium: 99 h

Lecture slides are available via eLearning-Platform ILIAS.
The type of examination (written or oral) will be announced at the beginning of the lecture:

- written examination: 90 min duration
- oral examination: 20 min duration
- auxiliary means: None

Media: Beamer

Workload:

- regular attendance: 21 h
- self-study: 99 h

Literature
Klein, B.: Leichtbau-Konstruktion. Vieweg & Sohn Verlag, 2007
10.248 Course: Localization of Mobile Agents [T-INFO-101377]

**Responsible:** Prof. Dr.-Ing. Uwe Hanebeck  
**Organisation:** KIT Department of Informatics  
**Part of:**  
- M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering  
- M-MACH-102609 - Major Field: Cognitive Technical Systems  
- M-MACH-102633 - Major Field: Robotics

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**Events**

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<td>Localization of Mobile Agents</td>
<td>3 SWS</td>
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**Exams**

**Literature**

Grundlegende Kenntnisse der linearen Algebra und Stochastik sind hilfreich.

---

Below you will find excerpts from events related to this course:

### Localization of Mobile Agents

24613, SS 2021, 3 SWS, Language: German, Open in study portal

**Lecture (V) Online**

**Content**

This module provides a systematic introduction into the topic of localization methods. In order to facilitate understanding, the module is divided into four main topics. Dead reckoning treats the instantaneous determination of a vehicle's position based on dynamic parameters like velocity or steering angle. Localization with the help of measurements of known landmarks is part of static localization. In addition to the closed-form solutions for particular measurements (distances and angles), the least squares method for fusion arbitrary measurements is also introduced. Dynamic localization treats the combination of dead reckoning and static localization. The central part of the lecture is the derivation of the Kalman filter, which has been successfully applied in several practical applications. Finally, simultaneous localization and mapping (SLAM) is introduced, which allows localization in case of (partly) unknown landmark positions.

**Organizational issues**

Prüfungsterminvorschläge und das Verfahren dazu sind auf der Webseite der Vorlesung zu finden.

**Literature**

Grundlegende Kenntnisse der linearen Algebra und Stochastik sind hilfreich.
10 COURSES

Course: Logistics and Supply Chain Management [T-MACH-110771]

10.249

Course: Logistics and Supply Chain Management [T-MACH-110771]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102625 - Major Field: Information Technology of Logistic Systems

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Exams

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<td>Logistics and Supply Chain Management</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate

The success control takes place in form of a written examination (60 min) during the semester break (according to §4(2), 1 SPO). If the number of participants is low, an oral examination (according to §4 (2), 2 SPO) may also be offered.

Prerequisites

None

Annotation

The brick cannot be taken if one of the bricks "T-MACH-102089 – Logistics - Organisation, Design and Control of Logistic Systems" and "T-MACH-105181 – Supply Chain Management" has been taken.

Below you will find excerpts from events related to this course:

V Logistics and Supply Chain Management

2118078, SS 2021, 4 SWS, Language: English, Open in study portal

Lecture (V) Online

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 (also in times during and after Corona) requires working in an international environment and therefore many terms are derived from English, the lecture will be held in English.
10.250 Course: Machine Dynamics [T-MACH-105210]

Responsible: Prof. Dr.-Ing. Carsten Proppe

Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
- M-MACH-102599 - Major Field: Powertrain Systems
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102636 - Major Field: Thermal Turbomachines
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
- M-MACH-102742 - Fundamentals and Methods of Production Technology
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
- M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems
- M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics
- M-MACH-104443 - Major Field: Vibration Theory

### Events

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<td>Lecture</td>
<td>Proppe</td>
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</table>

Competence Certificate

written exam, 180 min.

Prerequisites

none

Below you will find excerpts from events related to this course:

### Content

1. Introduction
2. Machine as mechatronic system
3. Rigid rotors: equations of motion, transient and stationary motion, balancing
4. Flexible rotors: Laval rotor (equations of motion, transient and stationary behavior, critical speed, secondary effects, refined models)
5. Slider-crank mechanisms: kinematics, equations of motion, mass and power balancing

### Literature

Biezeno, Grammel: Technische Dynamik, 2. Aufl., 1953

Holzweißig, Dresig: Lehrbuch der Maschinendynamik, 1979

Dresig, Vulfson: Dynamik der Mechanismen, 1989
Machine Dynamics (Tutorial)
2161225, SS 2021, 1 SWS, Language: English, Open in study portal
Practice (Ü)
Online

Content
Exercises related to the lecture

Machine Dynamics
2161224, WS 21/22, 2 SWS, Language: English, Open in study portal
Lecture (V)
Online

Content
1. Introduction
2. Machine as mechatronic system
3. Rigid rotors: equations of motion, transient and stationary motion, balancing
4. Flexible rotors: Laval rotor (equations of motion, transient and stationary behavior, critical speed, secondary effects), refined models
5. Slider-crank mechanisms: kinematics, equations of motion, mass and power balancing

Literature
Biezeno, Grammel: Technische Dynamik, 2. Aufl., 1953
Holzweißig, Dresig: Lehrbuch der Maschinendynamik, 1979
Dresig, Vulfson: Dynamik der Mechanismen, 1989
10.251 Course: Machine Dynamics II [T-MACH-105224]

**Responsible:** Prof. Dr.-Ing. Carsten Proppe  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102599 - Major Field: Powertrain Systems  
- M-MACH-102614 - Major Field: Mechatronics  
- M-MACH-102636 - Major Field: Thermal Turbomachines  
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains  
- M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics  
- M-MACH-104443 - Major Field: Vibration Theory

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**Events**

- **ST 2021** 2162220 Machine Dynamics II 2 SWS Lecture / Online Proppe, Oestringer
- **WT 21/22** 2162220 Machine Dynamics II 2 SWS Lecture / Online Proppe

**Exams**

- **ST 2021** 76-T-MACH-105224 Machine Dynamics II Proppe
- **WT 21/22** 76-T-MACH-105224 Machine Dynamics II Proppe

**Competence Certificate**  
oral exam, 30 min.

**Prerequisites**  
none

**Recommendation**  
Machine Dynamics

Below you will find excerpts from events related to this course:

**Machine Dynamics II**  
2162220, SS 2021, 2 SWS, Language: English, [Open in study portal](#)

**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
  - vibration of turbine blades

**Literature**  

**Machine Dynamics II**  
2162220, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)

**Content**  
hydrodynamic bearings

- rotating shafts in hydrodynamic bearings
- belt drives
- vibration of turbine blades
Literature
## 10.252 Course: Machine Tools and High-Precision Manufacturing Systems [T-MACH-110962]

### Responsible:
Prof. Dr.-Ing. Jürgen Fleischer

### Organisation:
KIT Department of Mechanical Engineering

### Part of:
- M-MACH-102601 - Major Field: Automation Technology
- M-MACH-102605 - Major Field: Engineering Design
- M-MACH-102618 - Major Field: Production Technology

### Type:
- Oral examination

### Credits:
- 8

### Grading scale:
- Grade to a third

### Recurrence:
- Each winter term

### Version:
- 1

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### Events

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### Exams

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Legend: 🖥 Online, 🧬 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

### Competence Certificate
Oral exam (40 minutes)

### Prerequisites
- T-MACH-102158 - Machine Tools and Industrial Handling must not be commenced.
- T-MACH-109055 - Machine Tools and Industrial Handling must not be commenced.
- T-MACH-110963 - Machine Tools and High-Precision Manufacturing Systems must not be commenced.

---

Below you will find excerpts from events related to this course:

### Machine Tools and High-Precision Manufacturing Systems

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<td>2149910</td>
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<td>German</td>
<td>Lecture / Practice (VÜ) Blended (On-Site/Online)</td>
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2149910, WS 21/22, 6 SWS, Language: German, Open in study portal
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
Start: 18.10.2021

Lectures on Mondays and Wednesdays, tutorial on Thursdays. The tutorial dates will announced in the first lecture.

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/).
10.253 Course: Machine Vision [T-MACH-105223]

**Responsible:** Dr. Martin Lauer  
Prof. Dr.-Ing. Christoph Stiller

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102598 - Major Field: Advanced Mechatronics  
M-MACH-102601 - Major Field: Automation Technology  
M-MACH-102609 - Major Field: Cognitive Technical Systems  
M-MACH-102624 - Major Field: Information Technology  
M-MACH-102633 - Major Field: Robotics

**Events**

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**Exams**

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<td>Machine Vision</td>
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**Legend:**  
Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

Type of Examination: written exam  
Duration of Examination: 60 minutes

**Prerequisites**

None

Below you will find excerpts from events related to this course:

**Machine Vision**

2137308, WS 21/22, 4 SWS, Language: English, Open in study portal

**Content**

Lernziele (EN):

*Machine vision (or computer vision)* describes all kind of techniques that can be used to extract information from camera images in an automated way. Considerable improvements of machine vision techniques throughout recent years, e.g. by the advent of deep learning, have caused growing interest in these techniques and enabled applications in various domains, e.g. robotics, autonomous driving, gaming, production control, visual inspection, medicine, surveillance systems, and augmented reality.

The participants should gain an overview over the basic techniques in machine vision and obtain hands-on experience.

Nachweis: written exam, 60 min.

Arbeitsaufwand: 240 hours

Voraussetzungen: none

**Literature**

Foliensatz zur Veranstaltung wird als kostenlose pdf-Datei bereitgestellt. Weitere Empfehlungen werden in der Vorlesung bekannt gegeben.
10.254 Course: Magnet Technology of Fusion Reactors [T-MACH-105434]

**Responsible:** Dr. Walter Fietz  
Dr. Klaus-Peter Weiss

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102643 - Major Field: Fusion Technology

<table>
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**Exams**

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**Legends:**  
🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Oral examination of about 30 minutes

**Prerequisites**

none

**Annotation**

none

*Below you will find excerpts from events related to this course:*

**Magnet Technology of Fusion Reactors**

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<td>Magnet Technology of Fusion Reactors</td>
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<td>German/English</td>
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Open in study portal
Content
In Greifswald/Germany the fusion experiment Wendelstein 7-X is now in operation to demonstrate the performance of Stellerator-type fusion machines. In south of France the fusion reactor ITER is under construction which will demonstrate the production of energy by fusion. In both machines the plasma inclusion will be ensured by magnets and to produce high magnetic fields in an efficient way, these magnets have to be superconducting. Design, construction and operation of such magnets is a technologic challenge because low temperature (4.5 K) and high currents (typ. 68 kA) are necessary.

The lecture will show basic principles for design and construction of such magnets and includes:

• Introduction with examples to nuclear fusion and to magnetic plasma confinement
• Basics of low temperature and high temperature properties and cryotechnique
• Material testing and critical material properties at low temperatures
• Principles of magnet design, construction and safe magnet operation
• Present status and magnet examples from fusion projects ITER, W7-X and JT-60SA
• Application of high temperature superconductors on fusion and power engineering

The goal of the lecture is to impart the fundamentals of construction of superconducting magnets. Magnet technology is inherently of multidisciplinary character e.g. material properties at low temperature, high voltage and high current technique. The use of superconductors is mandatory to reach highest magnetic fields with comparable small losses. Examples of magnets from power application, basic research and fusion reactor construction are discussed.

Lecture Content:

• Basics of nuclear fusion and design aspects of fusion magnets
• Superconductors - basics and stability
• Low temperature cryogenic aspects
• Low temperature and high temperature superconductors
• Cryogenic material testing and properties of fusion materials at low temperatures
• Quench and high voltage aspects for magnets
• Status and magnets of fusion machines ITER, W7-X, JT-60SA & future DEMO
• Impact of high temperature superconductors on fusion and power engineering

Educational objective: The students know:

• Magnetic plasma confinement principles in connection with fusion machine
• Examples and basic properties of different superconductors
• Basics of formation of superconducting cables and magnet construction
• Generation of low temperature, cryostat construction
• Basics of magnet design and magnet safety
• Material testing and material properties at low temperatures
• High-temperature superconductor use in magnet construction and power application

Recommendations:
Knowledge in energy technology, power plants, material testing is welcomed
- Time of attendance: 2 SWS, Other: excursion, etc. 5 hours
- Self-study: preparation and postprocessing LV (course): 1 hour / week
- Preparation for the examination: 80 hours per semester

Oral examination of about 30 minutes
## 10.255 Course: Magnetohydrodynamics [T-MACH-105426]

### Responsible:
apl. Prof. Dr. Leo Bühler

### Organisation:
KIT Department of Mechanical Engineering

### Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102634 - Major Field: Fluid Mechanic
- M-MACH-102643 - Major Field: Fusion Technology

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### Events

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<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Lecturer</th>
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<tbody>
<tr>
<td>WT</td>
<td>21</td>
<td>Magnetohydrodynamics</td>
<td>2 SWS</td>
<td>Lecture</td>
<td>Bühler</td>
<td>Each winter term</td>
<td>Bühler</td>
</tr>
<tr>
<td>ST</td>
<td>2021</td>
<td>Magnetohydrodynamics</td>
<td>2 SWS</td>
<td>Lecture</td>
<td>Bühler</td>
<td></td>
<td></td>
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</tbody>
</table>

### Prerequisites
The partial performance number T-MACH-108845 "Magnetohydrodynamics" (Nat/Inf/En) must not be startet or completed. The partial services T-MACH-108845 "Magnetohydrodynamics" (Nat/Inf/En) and T-MACH-105426 "Magnetohydrodynamics" are mutually exclusive.

### Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-108845 - Magnetohydrodynamics must not have been started.

### Recommendation
Fluid Mechanics (T-MACH-105207)
Mathematical Methods in Fluid Mechanics (T-MACH-105295)

### Below you will find excerpts from events related to this course:

<table>
<thead>
<tr>
<th>Content</th>
<th>Lecture (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Online</td>
</tr>
</tbody>
</table>

### Content
- Introduction
- Basics of electro and fluid dynamics
- Exact solutions, Hartmann flow, pump, generator, channel flows
- Inductionless approximation
- Developing flows, change of cross-section, variable magnetic fields
- Alfvén waves
- Stability, transition to turbulence
- Liquid dynamos

Educational objective: The students can describe the fundamentals of magnetohydrodynamics. They are qualified to explain the interrelations of electro and fluid dynamics so as to analyze magnetohydrodynamic flows in engineering applications or for phenomena in geo and astrophysics.
Literature
R. Moreau, 1990, Magnetohydrodynamics, Kluwer Academic Publisher
10.256 Course: Magnetohydrodynamics [T-MACH-108845]

**Responsible:** apl. Prof. Dr. Leo Bühler

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

<table>
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**Events**

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<th>Grade</th>
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<tbody>
<tr>
<td>WT 21/22</td>
<td>Magnetohydrodynamics</td>
<td>2 SWS</td>
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<tr>
<td>ST 2021</td>
<td>Magnetohydrodynamics</td>
<td>2 SWS</td>
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**Exams**

<table>
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<tr>
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<th>Grade</th>
<th>Responsible</th>
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<tr>
<td>Lecture / Online</td>
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<td></td>
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</tr>
<tr>
<td>Bühler</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Competence Certificate**

The study performance is considered to have been passed if all exercise assignments have been successfully processed and the final colloquium (30 minutes) has been successfully passed.

No auxiliary mean

**Prerequisites**

The partial performance number T-MACH-105426 "Magnetohydrodynamics" must not be started or completed. The partial services T-MACH-108845 "Magnetohydrodynamics" (Nat/Inf/Elit) and T-MACH-105426 "Magnetohydrodynamics" are mutually exclusive.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-105426 - Magnetohydrodynamics must not have been started.

**Recommendation**

Fluid Mechanics (T-MACH-105207)
Mathematical Methods in Fluid Mechanics (T-MACH-106295)

**Below you will find excerpts from events related to this course:**

**Magnetohydrodynamics**

2153429, WS 21/22, 2 SWS, Language: German/English, Open in study portal

**Content**

- Introduction
- Basics of electro and fluid dynamics
- Exact solutions, Hartmann flow, pump, generator, channel flows
- Inductionless approximation
- Developing flows, change of cross-section, variable magnetic fields
- 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
R. Moreau, 1990, Magnetohydrodynamics, Kluwer Academic Publisher
# 10.257 Course: Manufacturing Technology [T-MACH-102105]

**Responsible:** Prof. Dr.-Ing. Volker Schulze  
Dr.-Ing. Frederik Zanger  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-102605 - Major Field: Engineering Design  
M-MACH-102618 - Major Field: Production Technology

<table>
<thead>
<tr>
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<td>Each winter term</td>
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**Events**

<table>
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<th>SWS</th>
<th>Type</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>WT 21/22</td>
<td>2149657</td>
<td>Manufacturing Technology</td>
<td>6</td>
<td>Lecture / Practice ( / 💻)</td>
<td>Schulze, Gerstenmeyer</td>
</tr>
</tbody>
</table>

**Exams**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>SWS</th>
<th>Type</th>
<th>Lecturer</th>
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<tr>
<td>ST 2021</td>
<td>Manufacturing Technology</td>
<td>0</td>
<td>Schulze</td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**  
- 🖥 Online  
- 💻 Blended (On-Site/Online)  
- 🔗 On-Site  
- ☑️ Cancelled

**Competence Certificate**

Written Exam (180 min)

**Prerequisites**

none

Below you will find excerpts from events related to this course:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Type</th>
<th>SWS</th>
<th>Language</th>
<th>Open in study portal</th>
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<tbody>
<tr>
<td>2149657</td>
<td>Manufacturing Technology</td>
<td>Lecture / Practice (VÜ)</td>
<td>6</td>
<td>German</td>
<td>Open in study portal</td>
</tr>
</tbody>
</table>

**Course: Manufacturing Technology [T-MACH-102105]**

Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021  
Module Handbook, valid from Winter Term 2021/2022
Content
The objective of the lecture is to look at manufacturing technology within the wider context of production engineering, to provide an overview of the different manufacturing processes and to impart detailed process knowledge of the common processes. The lecture covers the basic principles of manufacturing technology and deals with the manufacturing processes according to their classification into main groups regarding technical and economic aspects. The lecture is completed with topics such as process chains in manufacturing.

The following topics will be covered:

- Quality control
- Primary processing (casting, plastics engineering, sintering, additive manufacturing processes)
- Forming (sheet-metal forming, massive forming, plastics engineering)
- Cutting (machining with geometrically defined and geometrically undefined cutting edges, separating, abrading)
- Joining
- Coating
- Heat treatment and surface treatment
- Process chains in manufacturing

This lecture provides an excursion to an industry company.

Learning Outcomes:
The students ...

- are capable to specify the different manufacturing processes and to explain their functions.
- are able to classify the manufacturing processes by their general structure and functionality according to the specific main groups.
- have the ability to perform a process selection based on their specific characteristics.
- are enabled to identify correlations between different processes and to select a process regarding possible applications.
- are qualified to evaluate different processes regarding specific applications based on technical and economic aspects.
- are experienced to classify manufacturing processes in a process chain and to evaluate their specific influence on surface integrity of workpieces regarding the entire process chain.

Workload:
regular attendance: 63 hours
self-study: 177 hours

Organizational issues
Start: 18.10.2021
Vorlesungstermine montags und dienstags, Übungstermine mittwochs. Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung.

Literature
Medien:
Skript zur Veranstaltung wird über ilias (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
Lecture notes will be provided in ilias (https://ilias.studium.kit.edu/).
Competence Certificate
The master thesis is designed to show that the student is able to deal with a problem of his/her subject area in an independent manner and within the given period of time using scientific methods.

The maximal processing time of the master thesis takes three months. With consent of the examiner the thesis can be written in another language than German as well. The date of issue of the subject has to be fixed by the supervisor and the student and to be put on record at the examination board. The subject of the master thesis may be only returned once and only within the first month of processing time.

On a reasoned request of the student, the examination board can extend the processing time by up to one month. If the master thesis is not completed in time, this examination is "failed" (5,0), unless the student is not responsible.

The 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 within a period of six weeks after the submission.

Prerequisites
The requirement for admission to the master thesis module are 74 ECTS. As to exceptions, the examination board decides on a request of the student (see § 14 (1) SPO).

Modeled Conditions
The following conditions have to be fulfilled:

1. You need to earn at least 74 credits in the following fields:
   - Advanced Engineering Fundamentals
   - Specialization

Final Thesis
This course represents a final thesis. The following periods have been supplied:

- Submission deadline: 6 months
- Maximum extension period: 3 months
- Correction period: 6 weeks

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102629 - Major Field: Logistics and Material Flow Theory

Events

<table>
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<tr>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<td>Each winter term</td>
<td>3</td>
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</table>

Competence Certificate
The assessment (Prüfungsleistung anderer Art) consists of the following assignments:

- 40% assessment of the final case study as individual performance,
- 60% semester evaluation which includes working on 5 case studies and defending those (For both assessment types, the best 4 of 5 tries count for the final grade.):
  - 40% assessment of the result of the case studies as group work,
  - 20% assessment of the oral examination during the case study colloquiums as individual performance.

A detailed description of the learning control can be found under Annotations.

Prerequisites
none

Recommendation
Recommended elective subject: Probability Theory and Statistics

Annotation
Students are divided into groups for this course. Five case studies are carried out in these groups. The results of the group work during the lecture period are presented and evaluated in writing. In the oral examination during the case study colloquiums, the understanding of the result of the group work and the models dealt with in the course is tested. The participation in the oral defenses is compulsory and will be controlled. For the written submission the group receives a common grade, in the oral defense each group member is evaluated individually.

After the lecture period, there is the final case study. This case study contains the curriculum of the whole semester. The students work individually on this case study which takes place at a predefined place and time (duration: 4h).

Below you will find excerpts from events related to this course:

Material flow in logistic systems
2117051, WS 21/22, 15 SWS, Language: German, Open in study portal

Others (sonst.)
## Content

### Learning Content:

- Elements of material flow systems (conveyor elements, fork, join elements)
- Models of material flow networks using graph theory and matrices
- Queueing theory, calculation of waiting time, utilization
- Warehouseing and order-picking
- Shuttle systems
- Sorting systems
- Simulation
- Calculation of availability and reliability
- Value stream analysis

After successful completion of the course, you are able (alone and in a team) to:

- Accurately describe a material handling system in a conversation with an expert.
- Model and parameterize the system load and the typical design elements of a material handling system.
- Design a material handling system for a task.
- Assess the performance of a material handling system in terms of the requirements.
- Change the main lever for influencing the performance.
- Expand the boundaries of today's methods and system components conceptually if necessary.

### Literature:

Arnold, Dieter; Furmans, Kai: Materialfluss in Logistiksystemen; Springer-Verlag Berlin Heidelberg, 7. Auflage 2019

### Description:

This course is separated into 5 topic blocks which are structured in the following parts:

- self-study phase
- exercise
- plenary
- case study (group work)
- colloquium
- review of case study

The groups for the case study will be formed at the beginning of the course (first week). The results of the group work during the lecture period are presented and evaluated in writing. During the colloquiums, the result of the case study is presented and the understanding of the group work and the models dealt with in the course are tested in an oral defense. The participation in the colloquiums is compulsory and will be controlled. For the written submission and the presentation the group receives a common grade, in the oral defense each group member is evaluated individually.

After the lecture period, there is the final case study. This case study contains the curriculum of the whole semester. The students work individually on this case study which takes place at a predefined place and time (duration: 4h).

**We strongly recommend to attend the introductory session on 20th of October 2021. In this session, the teaching concept of "Materialfluss in Logistiksysteme" is explained and outstanding issues are clarified.**

The course registration including the group allocation with ILIAS is mandatory. The registration will be open for several days after the introductory session (registration duration: 20.10.2021 14:00 Uhr - 26.10.2021 14:00 Uhr)

### Workload:

- Regular attendance: 35 h
- Self-study: 135 h
- Group work: 100 h

### Competence Certificate:

The assessment (Prüfungsleistung anderer Art) consists of the following assignments:

- 40% assessment of the final case study as individual performance,
- 60% semester evaluation which includes working on 5 case studies and defending those (For both assessment types, the best 4 of 5 tries count for the final grade.):
  - 40% assessment of the result and the presentation of the case studies as group work,
  - 20% assessment of the oral examination during the colloquiums as individual performance.
1.0.260 Course: Materials Characterization [T-MACH-107684]

**Responsible:** Dr.-Ing. Jens Gibmeier

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102611 - Major Field: Materials Science and Engineering

<table>
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<tr>
<th>Type</th>
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<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<td>Each summer term</td>
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<th>Events</th>
<th>Credits</th>
<th>Type</th>
<th>Exams</th>
<th>Credits</th>
<th>Type</th>
<th>Recurrence</th>
<th>Version</th>
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<tbody>
<tr>
<td>ST 2021</td>
<td>2174586</td>
<td>Materials Characterization</td>
<td>2 SWS</td>
<td>Lecture / 🖥</td>
<td>Schneider, Gibmeier</td>
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<td>ST 2021</td>
<td>76-T-MACH-107684</td>
<td>Materials Characterization</td>
<td>Gibmeier</td>
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<td>WT 21/22</td>
<td>76-T-MACH-107684</td>
<td>Materials Characterization</td>
<td>Gibmeier</td>
<td></td>
<td></td>
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</tbody>
</table>

**Competence Certificate**

- Oral exam, about 25 minutes

**Prerequisites**

Successful participation in Übungen zu Werkstoffanalytik is the condition for the admittance to the oral exam in Werkstoffanalytik.

T-MACH-110945 – Exercises for Materials Characterization has not been started.

T-MACH-110946 – Materials Characterization has not been started.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-107685 - Exercises for Materials Characterization must have been passed.

**Below you will find excerpts from events related to this course:**

**Materials Characterization**

2174586, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**

The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

**learning objectives:**

The students have fundamental knowledge about methods of material analysis. They have a basic understanding to transfer this fundamental knowledge on problems in engineering science. Furthermore, the students have the ability to describe technical material by its microscopic and submicroscopic structure.

**Organizational issues**


The lecture will be online (asynchronous). The lecture notes, supplementary material and the recording of lecture slides with audio track will be managed via ILIAS. The registration will be possible without restriction until 30.04.2021. Subsequently, registration is only possible by direct contacting Dr.-Ing. Jens Gibmeier. In summer term 2021 the lecture will be in German. The English course will be offered in winter term 2021 (starting in October 2021)
Literature
Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).
Literatur wird zu Beginn der Veranstaltung bekanntgegeben.
10.261 Course: Materials in Additive Manufacturing [T-MACH-110165]

Responsible: Dr.-Ing. Stefan Dietrich
Prof. Dr.-Ing. Volker Schulze

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102611 - Major Field: Materials Science and Engineering

**Type**
Oral examination

**Credits**
4

**Grading scale**
Grade to a third

**Recurrence**
Each winter term

**Version**
1

<table>
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<tr>
<th>Events</th>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
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<tbody>
<tr>
<td>WT 21/22</td>
<td>Lecture / 🧩</td>
<td>4</td>
<td>Grade to a third</td>
<td>Each winter term</td>
<td>1</td>
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</table>

Responsible: Dietrich

Competence Certificate
oral exam, about 25 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

Materials in Additive Manufacturing
2173600, WS 21/22, 2 SWS, Language: German, Open in study portal

Content
learning objectives:

requirements:
none

workload:

Organizational issues
Di, 14:00 - 15:30, 10.81 Emil Mosonyi-Hörsaal (HS 62) soll bleiben
10.262 Course: Materials Modelling: Dislocation Based Plasticy [T-MACH-105369]

**Responsible:** Dr. Daniel Weygand

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
- M-MACH-102611 - Major Field: Materials Science and Engineering
- M-MACH-102646 - Major Field: Applied Mechanics

<table>
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<th>Grading scale</th>
<th>Recurrence</th>
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<tr>
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**Events**

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<th>Recurrence</th>
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<tr>
<td>ST 2021</td>
<td>2182740</td>
<td>Materials modelling: dislocation based plasticy</td>
<td>Lecture</td>
<td>2</td>
<td>Each summer term</td>
</tr>
<tr>
<td>ST 2021</td>
<td>76-T-MACH-105369</td>
<td>Materials Modelling: Dislocation Based Plasticity</td>
<td>Lecture</td>
<td>2</td>
<td>Each summer term</td>
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<tr>
<td>WT 21/22</td>
<td>76-T-MACH-105369</td>
<td>Materials Modelling: Dislocation Based Plasticity</td>
<td>Lecture</td>
<td>2</td>
<td>Each summer term</td>
</tr>
</tbody>
</table>

**Legend:**
- Online
- Blended (On-Site/Online)
- On-Site
- Cancelled

**Competence Certificate**
oral exam ca. 30 minutes

**Prerequisites**
none

**Recommendation**
preliminary knowledge in mathematics, physics and materials science

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**Below you will find excerpts from events related to this course:**

**Materials modelling: dislocation based plasticy**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Type</th>
<th>SWS</th>
<th>Language: German, Open in study portal</th>
</tr>
</thead>
<tbody>
<tr>
<td>2182740</td>
<td>Materials modelling: dislocation based plasticy</td>
<td>Lecture</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**Content**

1. Introduction
2. elastic fields of dislocations
3. slip, crystallography
4. equations of motion of dislocations
   a) fcc
   b) bcc
5. interaction between dislocations
6. molecular dynamics
7. discrete dislocation dynamics
8. continuum description of dislocations

The student
- has the basic understanding of the physical basics to describe dislocations and their interaction with point, line and area defects.
- can apply modelling approaches for dislocation based plasticity.
- can explain discrete methods for modelling of microstructural evolution processes.

preliminary knowledge in mathematics, physics and materials science recommended

regular attendance: 22.5 hours
self-study: 97.5 hours
oral exam ca. 30 minutes
Organizational issues

- Kursbeitritt erfolgt bis zum 13.4.2021 (erste Vorlesung) ohne Passwort.
- Die Veranstaltung wird in MSTeams online gehalten
- Die Vorlesungsfolien und eine Audiobesprechung der wichtigsten Elemente der Vorlesung werden über ILIAS zugänglich gemacht.

Literature

10.263 Course: Materials of Lightweight Construction [T-MACH-105211]

**Responsible:** Prof. Dr.-Ing. Peter Elsner
Dr.-Ing. Wilfried Liebig

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102611 - Major Field: Materials Science and Engineering
- M-MACH-102628 - Major Field: Lightweight Construction

<table>
<thead>
<tr>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
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<tbody>
<tr>
<td>Oral examination</td>
<td>4</td>
<td>Grade to a third</td>
<td>Each summer term</td>
<td>1</td>
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</table>

**Events**

| ST 2021 | 2174574 | Materials of Lightweight Construction | 2 SWS | Lecture / 🖥️ | Liebig, Elsner |

**Exams**

| ST 2021 | 76-T-MACH-105211 | Materials of Lightweight Construction | Liebig |

**Legend:** 🖥️ Online, 🧩 Blended (On-Site/Online), 🔊 On-Site, ☑ Cancelled

**Competence Certificate**
Oral exam, about 25 minutes

**Prerequisites**
none

**Recommendation**
Materials Science I/II

Below you will find excerpts from events related to this course:

**Materials of Lightweight Construction**
2174574, SS 2021, 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
10.264 Course: Materials Recycling and Sustainability [T-MACH-110937]

**Responsible:** Prof. Dr.-Ing. Peter Elsner
Dr.-Ing. Wilfried Liebig

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102611 - Major Field: Materials Science and Engineering
- M-MACH-102618 - Major Field: Production Technology
- M-MACH-102628 - Major Field: Lightweight Construction
- M-MACH-102632 - Major Field: Polymer Engineering

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<th>Recurrence</th>
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<tbody>
<tr>
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<td>4</td>
<td>Grade to a third</td>
<td>Each summer term</td>
<td>2</td>
</tr>
</tbody>
</table>

**Competence Certificate**
oral exam (about 25 min.)

**Prerequisites**
none
10.265 Course: Materials Science and Engineering III [T-MACH-105301]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102611 - Major Field: Materials Science and Engineering

Type: Oral examination
Credits: 8
Grading scale: Grade to a third
Recurrence: Each winter term
Version: 2

Events

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<th>Events</th>
<th>Code</th>
<th>Title</th>
<th>SWS</th>
<th>Type</th>
<th>Grading</th>
<th>Lecturer</th>
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<tbody>
<tr>
<td>WT 21/22</td>
<td>2173553</td>
<td>Materials Science and Engineering III</td>
<td>4</td>
<td>Lecture / Online</td>
<td>Heilmaier, Guth</td>
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<td>WT 21/22</td>
<td>2173554</td>
<td>Exercises in Materials Science and Engineering III</td>
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<td>Practice / Online</td>
<td>Heilmaier, Kauffmann</td>
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Exams

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<td>76-T-MACH-105301</td>
<td>Materials Science III</td>
<td>1</td>
<td>Practice / Online</td>
<td>Heilmaier, Guth</td>
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</table>

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Oral exam, about 35 minutes

Prerequisites
T-MACH-110818 - Plasticity of Metals and Intermetallics has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110818 - Plasticity of Metals and Intermetallics must not have been started.

Below you will find excerpts from events related to this course:

Materials Science and Engineering III
2173553, WS 21/22, 4 SWS, Language: German, Open in study portal
Lecture (V)
Blended (On-Site/Online)

Content
Properties of pure iron; thermodynamic foundations of single-component and of binary systems; nucleation and growth; diffusion processes in crystalline iron; the phase diagram Fe-Fe3C; effects of alloying on Fe-C-alloys; nonequilibrium microstructures; multicomponent iron-based alloys; heat treatment technology; hardenability and hardenability tests.

learning objectives:
The students are familiar with the thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid states (nucleation and growth phenomena), the mechanisms of microstructure formation and microstructure-property relationships and can apply them to metallic materials. They can assess the effects of heat treatments and of alloying on the microstructure and the properties of iron-based materials (steels in particular). The can select steels for structural applications in mechanical engineering and subject them to appropriate heat treatments.

requirements:
Basic knowledge in materials science and engineering (Werkstoffkunde I/II)

workload:
regular attendance: 53 hours
self-study: 187 hours

Literature
Vorlesungsskript; Übungsaufgaben; Bhadeshia, H.K.D.H. & Honeycombe, R.W.K.
Steels – Microstructure and Properties
### 10.266 Course: Mathematical Fundamentals of Numerical Mechanics [T-MACH-108957]

**Responsible:** Prof. Dr. Eckart Schnack  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102614 - Major Field: Mechatronics

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<th>Version</th>
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<td>Each summer term</td>
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**Events**

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<th>Recurrence</th>
<th>Version</th>
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**Exams**

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<th>Recurrence</th>
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<td>ST 2021</td>
<td>Oral examination</td>
<td>4</td>
<td>Grade to a third</td>
<td>Each summer term</td>
<td>1</td>
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</tbody>
</table>

**Competence Certificate**  
Oral Examination Duration: 20 minutes

**Prerequisites**

None

**Recommendation**

none

Below you will find excerpts from events related to this course:

**Mathematical Fundamentals of Numerical Mechanics**  
2162240, SS 2021, 2 SWS, Language: German, Open in study portal  
Lecture (V)  
On-Site

**Content**  
Variational formulations, Functional analysis, Lagrange d process, Various function space definitions relating to the elasticity and dynamics of the mechanics. Measurements which enable the field calculation to be defined in applications.

**Literature**

**Course: Mathematical Methods in Continuum Mechanics [T-MACH-110375]**

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102594 - Mathematical Methods
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102742 - Fundamentals and Methods of Production Technology
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
- M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

**Type**
- Written examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each winter term

**Expansion**
- 1 terms

**Version**
- 1

**Events**

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<th>WT 21/22</th>
<th>2161254</th>
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<tr>
<td>Mathematical Methods in Continuum Mechanics</td>
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</table>
| 2 SWS | Lecture / 🧩 Böhlke

**Exams**

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<th>WT 21/22</th>
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<tbody>
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<td>Mathematical Methods in Continuum Mechanics</td>
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</table>

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗝 On-Site, ✗ Cancelled

**Competence Certificate**
- written exam (90 min). Additives as announced.

**Prerequisites**
- Passing the Tutorial to Mathematical Methods of Continuum Mechanics (T-MACH-110376)

**Modeled Conditions**
- The following conditions have to be fulfilled:
  1. The course T-MACH-110376 - Tutorial Mathematical Methods in Continuum Mechanics must have been passed.

**Below you will find excerpts from events related to this course:**

**Mathematical Methods in Continuum Mechanics**
- 2161254, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)
- Lecture (V)
- Blended (On-Site/Online)

**Content**

**Tensor algebra**
- vectors; basis transformation; dyadic product; tensors of 2nd order
- properties of 2nd order tensors: symmetry, anti-symmetry, orthogonality etc.
- eigenvalue problem, theorem of Cayley-Hamilton, invariants; tensors of higher order
- tensor algebra in curvilinear coordinate systems
- tensor analysis in curvilinear coordinate systems
- Differentiation of tensor functions

**Application of tensor calculus in strength of materials**
- kinematics of infinitesimal and finite deformations
- transport theorem, balance equations, stress tensor
- constitutive equations for solids and fluids
- Formulation of initial-boundary-value problems

**Literature**

- Vorlesungsskript
- Schade, H: Strömungslehre, de Gruyter 2013
Course: Mathematical Methods in Dynamics [T-MACH-105293]

**Responsible:** Prof. Dr.-Ing. Carsten Proppe  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering  
- M-MACH-102594 - Mathematical Methods  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102598 - Major Field: Advanced Mechatronics  
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering  
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology  
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction  
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering  
- M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics

**Type**  
Written examination

**Credits**  
6

**Grading scale**  
Grade to a third

**Recurrence**  
Each winter term

**Version**  
2

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**Events**

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<th>2 SWS</th>
<th>Lecture</th>
<th>Proppe</th>
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<tr>
<td>WT 21/22</td>
<td>2161206</td>
<td>Mathematical Methods in Dynamics</td>
<td>2 SWS</td>
<td>Lecture</td>
<td>Proppe</td>
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<tr>
<td>WT 21/22</td>
<td>2161207</td>
<td>Übungen zu Mathematische Methoden der Dynamik</td>
<td>1 SWS</td>
<td>Practice</td>
<td>Proppe, Oestringer</td>
</tr>
</tbody>
</table>

**Exams**

| ST 2021 | 76-T-MACH-105293 | Mathematical Methods in Dynamics | Proppe |

Legend:  
Online, Blended (On-Site/Online), On-Site, Cancelled

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**Competence Certificate**  
written examination, 180 min.

**Prerequisites**  
one

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Below you will find excerpts from events related to this course:

**Mathematical Methods in Dynamics**  
2161206, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**  
The students know precisely the mathematical methods of dynamics. They are able to use the basic mathematical methods for modelling the dynamical behaviour of elastic and rigid bodies. The students also have a basic understanding of the description of kinematics and kinetics of bodies. They also master the alternative formulations 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:  
Principle of virtual work, variational calculations, Principle of Hamilton

Approximate solution methods:  
Methods of weighted residuals, method of Ritz

---

Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021  
Module Handbook, valid from Winter Term 2021/2022
**Mathematical Methods in Dynamics**

V 2161206, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Content**

Dynamics of continua:
- Concept of continuum, geometry of continua, kinematics and kinetics of continua

Dynamics of rigid bodies:
- Kinematics and kinetics of rigid bodies

Variational principles:
- Principle of virtual work, variational calculations, Principle of Hamilton

Approximate solution methods:
- Methods of weighted residuals, method of Ritz

Applications

**Literature**

Vorlesungsskript (erhältlich im Internet)

J.E. Marsden, T.J.R. Hughes: Mathematical foundations of elasticity, New York, Dover, 1994

P. Haupt: Continuum mechanics and theory of materials, Berlin, Heidelberg, 2000

M. Riemer: Technische Kontinuumsmechanik, Mannheim, 1993


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**Übungen zu Mathematische Methoden der Dynamik**

V 2161207, WS 21/22, 1 SWS, Language: German, [Open in study portal](#)

**Content**

Exercises related to the lecture

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Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021
Module Handbook, valid from Winter Term 2021/2022
10 COURSES

Course: Mathematical Methods in Fluid Mechanics [T-MACH-105295]

**Responsible:** Prof. Dr.-Ing. Bettina Frohnapfel

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
- M-MACH-102594 - Mathematical Methods
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102634 - Major Field: Fluid Mechanics
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

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<td>Each summer term</td>
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<th>Duration</th>
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<td>2 SWS</td>
<td>Lecture</td>
<td>Frohnapfel</td>
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<td>ST 2021 2154433</td>
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<td>Tutorial in Mathematical Methods of Fluid Mechanics</td>
<td>1 SWS</td>
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<td>ST 2021 2154540</td>
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<td>Mathematical Methods in Fluid Mechanics</td>
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<th>Duration</th>
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<tbody>
<tr>
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<td>Mathematical Methods in Fluid Mechanics</td>
<td>Frohnapfel, Gatti</td>
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<td>ST 2021 76-T-MACH-105295 (engl.)</td>
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<td>Mathematical Methods in Fluid Mechanics</td>
<td>Frohnapfel, Gatti</td>
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**Competition Certificate**
written examination - 3 hours

**Prerequisites**
none

**Recommendation**
Basic Knowledge about Fluid Mechanics

**Below you will find excerpts from events related to this course:**

**V** Mathematical Methods in Fluid Mechanics
2154432, SS 2021, 2 SWS, Language: German/English, Open in study portal

Legend: ⚡ Online, 🎫 Blended (On-Site/Online), ⬜ On-Site, ⌠ Cancelled
Content
The students can to simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical method in fluid mechanics effectively in order to solve the resulting conservation equations analytically, if possible, or to enable simpler numerical access to the problem. They can describe the limits of applicability of the assumptions made to model the flow behavior.

The lecture will cover a selection of the following topics:

- Potential flow theory
- Creeping flows
- Lubrication theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows
- Numerical solution of the governing equation (finite difference methods)

The students can to simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical method in fluid mechanics effectively in order to solve the resulting conservation equations analytically, if possible, or to enable simpler numerical access to the problem. They can describe the limits of applicability of the assumptions made to model the flow behavior.

Literature

V Tutorial in Mathematical Methods of Fluid Mechanics
2154433, SS 2021, 1 SWS, Language: German, Open in study portal

Content
The exercises will practise the lecture topics:

- Curvilinear coordinates and tensor calculus
- Potential flow theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows
- Numerical solution of the governing equation (finite difference methods)

Organizational issues
Die Übungen zu Mathematische Methoden der Strömungslehre findet gemeinsam mit der englischen Übung statt.

Literature

V Mathematical Methods in Fluid Mechanics
2154540, SS 2021, SWS, Language: English, Open in study portal
Content
The students can simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical method in fluid mechanics effectively in order to solve the resulting conservation equations analytically, if possible, or to enable simpler numerical access to the problem. They can describe the limits of applicability of the assumptions made to model the flow behavior.

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### Course: Mathematical Methods in Micro Mechanics [T-MACH-111537]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102649 - Major Field: Advanced Materials Modelling

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<th>Expansion</th>
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<td>Grade to a third</td>
<td>1 terms</td>
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</table>

**Events**  
ST 2021 2162280 Mathematical Methods in Micromechanics 2 SWS Lecture / 🧩 Böhle, Kehrer

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), ⚪ On-Site, ⌚ Cancelled

**Competence Certificate**  
written exam (60 min)

**Prerequisites**  
none

**Annotation**  
can only be chosen within the Major Field 56 of MSc Mechanical Engineering

Below you will find excerpts from events related to this course:

### Mathematical Methods in Micromechanics  
2162280, SS 2021, 2 SWS, Language: German, Open in study portal  
Lecture (V) Blended (On-Site/Online)

**Content**  
Fundamentals of linear isotropic and anisotropic thermoelasticity theory,  
Description of microstructures,  
Micro-macro relations of linear thermoelasticity theory,  
Approximations and bounds for the effective thermoelastic material behavior,  
Microstructure Sensitive Design of materials,  
Selected problems in the context of homogenization of nonlinear material properties

**Organizational issues**  
Siehe Aushang am Institut bzw. Informationen auf der Webseite

**Literature**

- Vorlesungsskript  
- Klingbeil, E.: Variationsrechnung, BI Wissenschaftsverlag, 1977  
10.271 Course: Mathematical Methods in Micromechanics [T-MACH-110378]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102594 - Mathematical Methods
- M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
- M-MACH-102611 - Major Field: Materials Science and Engineering
- M-MACH-102646 - Major Field: Applied Mechanics
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
- M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

**Type:** Written examination

**Credits:** 5

**Grading scale:** Grade to a third

**Recurrence:** Each summer term

**Expansion:** 1 terms

**Version:** 2

**Events**

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<th>Event Code</th>
<th>Course Title</th>
<th>Term</th>
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<td>Grade to a third</td>
<td>Böhlke, Kehrer</td>
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**Exams**

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<tr>
<th>Event Code</th>
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<th>Credits</th>
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<tr>
<td>ST 2021</td>
<td>76-T-MACH-110401 Mathematical Methods in Micromechanics</td>
<td>2 SWS</td>
<td>Böhlke</td>
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</table>

**Legend:**
- 🖥 Online, 🧩 Blended (On-Site/Online), 🗟 On-Site, ✗ Cancelled

**Competition Certificate**

written exam (180 min). Additives as announced.

**Prerequisites**

prerequisite to registration to the exam: Passing the tutorial to Mathematical Methods in Micromechanics (T-MACH-110379)

**Prerequisites**

Passing the tutorial to Mathematical Methods in Micromechanics (T-MACH-110379)

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-110379 - Tutorial Mathematical Methods in Micromechanics must have been passed.

**Below you will find excerpts from events related to this course:**

**Mathematical Methods in Micromechanics**

2162280, SS 2021, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

Blended (On-Site/Online)

**Content**

Fundamentals of linear isotropic and anisotropic thermoelasticity theory,
Description of microstructures,
Micro-macro relations of linear thermoelasticity theory,
Approximations and bounds for the effective thermoelastic material behavior,
Microstructure Sensitive Design of materials,
Selected problems in the context of homogenization of nonlinear material properties

**Organizational issues**

Siehe Aushang am Institut bzw. Informationen auf der Webseite

**Literature**

- Vorlesungsskript
- Klingbeil, E.: Variationsrechnung, BI Wissenschaftsverlag, 1977
10.272 Course: Mathematical Methods in Structural Mechanics [T-MACH-105298]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering  
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction

<table>
<thead>
<tr>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<tbody>
<tr>
<td>Written examination</td>
<td>5</td>
<td>Grade to a third</td>
<td>Each summer term</td>
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**Events**

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<th>2162204</th>
<th>Consultation hour Mathematical Methods in Micromechanics</th>
<th>2 SWS</th>
<th>Consultation-hour (Sprechs / 🖥)</th>
<th>Karl, Krause</th>
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</table>

Legend: 🖥 Online, ☐ Blended (On-Site/Online), ☀ On-Site, ✗ Cancelled

**Competence Certificate**

Written exam (180 min). Additives as announced.

**Prerequisites**

Passing the tutorial to Mathematical Methods in Structural Mechanics T-MACH-106831

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-106831 - Tutorial Mathematical Methods in Structural Mechanics must have been passed.

**Recommendation**

This course is geared to MSc students. The contents of the lecture "Mathematical methods in Strength of Materials" are assumed to be known.
10.273 Course: Mathematical Methods of Vibration Theory [T-MACH-105294]

**Responsibility:** Prof. Dr.-Ing. Wolfgang Seemann

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102594 - Mathematical Methods
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
- M-MACH-102743 - Major Field: Modeling and Simulation in Dynamics
- M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics

**Events**

<table>
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<th>Type</th>
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<td>Written examination</td>
<td>Grade to a third</td>
<td>Each summer term</td>
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<td>Practice</td>
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<td>2</td>
<td>Mathematical methods of vibration theory (Tutorial)</td>
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</table>

**Exams**

| ST 2021 | 76-T-MACH-105294 | Mathematical Methods of Vibration Theory | Seemann |

**Prerequisites**

none

**Recommendation**

Engineering Mechanics III/IV

**Below you will find excerpts from events related to this course:**

### Mathematical methods of vibration theory

**2162241, SS 2021, 2 SWS, Language: German, Open in study portal**

**Lecture (V)**

Linear, time-invariant, ordinary single differential equations: homogeneous solution; harmonic, periodic and non-periodic excitations; Duhamel's integral; Fourier and Laplace transform; introduction into the theory of distributions; Systems of ordinary differential equations: matrix notation, eigenvalue theory, fundamental matrix, forced vibrations via modal expansion and transition matrix; Introduction into the dynamic stability theory; Partial differential equations: solution in product form, eigenvalue theory, modal expansion using Ritz series; Variational methods, Hamilton's principle, boundary value problems representing vibrating continua; Perturbation methods

**Literature**

Riemer, Wedig, Wauer: Mathematische Methoden der Technischen Mechanik

### Mathematical methods of vibration theory (Tutorial)

**2162242, SS 2021, 2 SWS, Language: German, Open in study portal**

**Practice (Ü)**

Seven tutorials with examples of the contents of the course
Literature
Riemer, Wedig, Wauer: Mathematische Methoden der Technischen Mechanik
10.274 Course: Mathematical Models and Methods for Production Systems [T-MACH-105189]

**Responsible:** Dr.-Ing. Marion Baumann  
Prof. Dr.-Ing. Kai Furmans

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering  
M-MACH-102594 - Mathematical Methods  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102613 - Major Field: Lifecycle Engineering  
M-MACH-102618 - Major Field: Production Technology  
M-MACH-102633 - Major Field: Robotics  
M-MACH-102742 - Fundamentals and Methods of Production Technology  
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

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**Events**

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<td>WT 21/22</td>
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<td>Mathematical models and methods for Production Systems</td>
<td>4 SWS</td>
<td>Lecture</td>
<td>6</td>
<td>Grade to a third</td>
<td>Each winter term</td>
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</table>

**Competence Certificate**

The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

**Prerequisites**

none

Below you will find excerpts from events related to this course:

**Mathematical models and methods for Production Systems**

2117059, WS 21/22, 4 SWS, Language: English, Open in study portal

Lecture (V)  
Blended (On-Site/Online)
Content

Media:
black board, lecture notes, presentations

Learning Content:

- single server systems: M/M/1, M/G/1: priority rules, model of failures
- networks: open and closed approximations, exact solutions and approximations
- application to flexible manufacturing systems, AGV (automated guided vehicles) - systems
- modeling of control approaches like constant work in process (ConWIP) or kanban
- discrete-time modeling of queuing systems

Learning Goals:

Students are able to:

- Describe queueing systems with analytical solvable stochastic models,
- Derive approaches for modeling and controlling material flow and production systems based on models of queueing theory,
- Use simulation and exact methods.

Recommendations:

- Basic knowledge of statistics recommended
- compulsory optional subject: Stochastics
- recommended lecture: Materials flow in logistic systems (also parallel)

Workload:

regular attendance: 42 hours
self-study: 198 hours

Literature

10.275 Course: Mathematical Models and Methods in Combustion Theory [T-MACH-105419]

**Responsible:** Dr. Viatcheslav Bykov  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering  
M-MACH-102635 - Major Field: Engineering Thermodynamics

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**Events**

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**Legend:** Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

Oral exam, approx. 20 min

**Prerequisites**

none

**Below you will find excerpts from events related to this course:**

**V** Mathematical models and methods in combustion theory  
2165525, WS 21/22, 2 SWS, Language: German, Open in study portal  
Lecture (V)  
Blended (On-Site/Online)

**Content**

The lecture shall introduce the basics of the mathematical modeling and the analysis of reacting flow systems. The fundamental models of combustion processes are outlined together with asymptotical methods, which deliver reasonable approximate solutions for numerous combustion processes. Many examples of simplified models for the description of auto-ignition, explosions, flame quenching and detonations will be presented and discussed. The main analytical methods will be illustrated using these simple examples.

**Organizational issues**

Termine und Raum: siehe Aushang und Internetseite des Instituts.

**Literature**

10.276 Course: Measurement [T-ETIT-101937]

Responsible: Prof. Dr.-Ing. Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102615 - Major Field: Medical Technology

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Exams

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<td>Heizmann</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
### Course: Measurement II [T-MACH-105335]

**Responsible:** Prof. Dr.-Ing. Christoph Stiller  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102598 - Major Field: Mechanical Engineering  
- M-MACH-102601 - Major Field: Automation Technology  
- M-MACH-102609 - Major Field: Cognitive Technical Systems  
- M-MACH-102614 - Major Field: Mechatronics  
- M-MACH-102624 - Major Field: Information Technology  
- M-MACH-102633 - Major Field: Robotics

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<td>Each summer term</td>
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</table>

**Events**

| ST 2021 | 2138326 | Measurement II | 2 SWS | Lecture / 🏫 | Stiller, Bieder |

**Exams**

| ST 2021 | 76-T-MACH-105335 | Measurement II | Stiller |

**Legend:**  
- 🖥 Online  
- 🧩 Blended (On-Site/Online)  
- 📢 On-Site  
- ❌ Cancelled

**Competence Certificate**

- Written exam  
  - 60 min.  
  - 2 DIN A4 self-created formular sheets allowed

**Prerequisites**

- none

*Below you will find excerpts from events related to this course:*
Content
Lerninhalt (EN)
1. Amplifiers
2. Digital technology
3. Stochastic modeling for measurement applications
4. Estimation
5. Kalman Filter
6. Environmental perception

Lernziele (EN):
The capabilities of modern sensor technology pave the way for novel applications in engineering. Especially digital measurement techniques may be used even in very complex environments and thus have strong impact on technological progress. Stochastic models of measurement processes form the basis for meaningful information processing and provide a valuable tool for engineering. This interdisciplinary lecture addresses students in mechanical engineering and related subjects. The lecture gives an overview of digital technology and stochastics. These areas form the basics of estimation methods that can be embedded elegantly in the theory of state observers. Applications in signal processing for modern environmental perception (video, Lidar, Radar) illustrate the discussed subjects.

Nachweis:
Written exam
60 minutes
Individual sheet of formulas

Arbeitsaufwand:
120 hours

Literature
Skript und Foliensatz zur Veranstaltung werden als kostenlose pdf-Dateien bereitgestellt. Weitere Empfehlungen werden in der Vorlesung bekannt gegeben.

Idealerweise haben Sie zuvor 'Grundlagen der Mess- und Regelungstechnik' gehört oder verfügen aus einer Vorlesung anderer Fakultäten über grundlegende Kenntnisse der Mess- und Regelungstechnik und der Systemtheorie.

10.278 Course: Measurement Instrumentation Lab [T-MACH-105300]

**Responsible:** Sven Richter  
Prof. Dr.-Ing. Christoph Stiller  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-102591 - Laboratory Course  

<table>
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**Events**

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<th>Type</th>
<th>Lecturer</th>
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<td>2 SWS</td>
<td>Practical course / On-Site</td>
<td>Stiller, Wang</td>
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**Exams**

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<th>Description</th>
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<td>Measurement Instrumentation Lab</td>
<td>Stiller</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Non graded colloquia

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

**Measurement Instrumentation Lab**  
2138328, SS 2021, 2 SWS, Language: German, [Open in study portal](#)  

**Practical course (P)**  
On-Site

**Content**

Please consider the bulletin on our website!

**A Signal recording**

- measurement of temperature
- measurement of lengths

**B Signal pre-processing**

- bridge circuits and principles of measurement  
- analog/digital transducers

**C Signal processing**

- measuring stochastic signals

**D Complete systems**

- system identification  
- inverse pendulum  
- mobile robot platform

**Recommendations:**

Basic studies and preliminary examination; basic lectures in automatic control  
Arbeitsaufwand: 90 hours

**Lernziele (EN):**

The laboratory complements the course "Introduction to Measurement and Control". While the course is organized into principles and subsystems, the laboratory presents complete measurement systems and methods for the most relevant industrial measurands.
**Literature**
Anleitungen auf der Homepage des Instituts erhältlich.
Instructions to the experiments are available on the institute's website
10.279 Course: Mechanics and Strength of Polymers [T-MACH-105333]

### Responsible:
Hon.-Prof. Dr. Bernd-Steffen von Bernstorff

### Organisation:
KIT Department of Mechanical Engineering

### Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102611 - Major Field: Materials Science and Engineering
- M-MACH-102632 - Major Field: Polymer Engineering

<table>
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<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<td>Grade to a third</td>
<td>Each winter term</td>
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### Events

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<th>Language</th>
<th>Course</th>
<th>Location</th>
<th>Event Type</th>
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<td>von Bernstorff</td>
<td>Lecture (L)</td>
<td>2 SWS</td>
<td>German</td>
<td>Mechanics and Strengths of Polymers</td>
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</table>

### Legend

- 🖥 Online
- 🧩 Blended (On-Site/Online)
- 🗣 On-Site
- ❌ Cancelled

### Competence Certificate

Oral exam, about 25 minutes

### Prerequisites

none

### Recommendation

Basic knowledge in materials science (e.g. lecture materials science I and II)

### Below you will find excerpts from events related to this course:

#### Mechanics and Strengths of Polymers

2173580, WS 21/22, 2 SWS, Language: German, [Open in study portal]

### Content

Molecular structure and morphology of polymers, temperature- and time dependency of mechanical behavior, viscoelasticity, time/temperature- superposition principle, yielding, crazing and fracture of polymers, failure criterions, impact and dynamic loading, corresponding principle, tough/brittle-transition, introduction to the principles of fiber reinforcement and multiple cracking in composites

**learning objectives:**

The students are prepared to

- repeat the calculus on strength and design of engineering parts exposed to complex loadings,
- estimate the influence of time and temperature on the strength of polymeric materials,
- relate the strength of materials to their molecular structure, morphology and processing parameters and
- derive failure mechanisms for homogenous polymers and composite materials therefrom.

### requirements:

basic knowledge in materials science (e.g. lecture materials science I and II)

### workload:

The workload for the lecture Mechanics and Strengths of Polymers is 120 h per semester and consists of the presence during the lecture (28 h) as well as preparation and rework time at home (92 h).

### Literature

Literaturliste, spezielle Unterlagen und ein Teilmanuskript werden in der Vorlesung ausgegeben
10.280 Course: Mechanics in Microtechnology [T-MACH-105334]

**Responsible:** Prof. Dr. Christian Greiner
Dr. Patric Gruber

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102616 - Major Field: Microsystems Technology
M-MACH-102647 - Major Field: Microactuators and Microsystems

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<td>Grade to a third</td>
<td>Each winter term</td>
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**Events**

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</table>

**Competence Certificate**

Oral examination, ca. 30 min

**Prerequisites**
none

**Below you will find excerpts from events related to this course:**

**Mechanics in Microtechnology**

2181710, WS 21/22, 2 SWS, Language: German, [Open in study portal]

Lecture (V), Blended (On-Site/Online)

**Content**

1. Introduction: Application and Processing of Microsystems
2. Scaling Effects
3. Fundamentals: Stress and Strain, (anisotropic) Hooke's Law
4. Fundamentals: Mechanics of Beams and Membranes
5. Thin Film Mechanics: Origin and Role of Mechanical Stresses
6. Characterization of Mechanical Properties of Thin Films and Small Structures: Measurement of Stresses and Mechanical Parameters such as Young's Modulus and Yield Strength; Thin Film Adhesion and Stiction
7. Transduction: Piezo-resistivity, Piezo-electric Effect, Electrostatics,...
8. Aktuation: Inverse Piezo-electric Effect, Shape Memory, Electromagnetic Actuation,...

The students know and understand size and scaling effects in micro- and nanosystems. They understand the impact of mechanical phenomena in small dimensions. Based on this they can judge how they determine material processing as well as working principles and design of microsensors and microactuators.

regular attendance: 22.5 hours
self-study: 97.5 hours
oral exam ca. 30 minutes

**Literature**

Folien,
2. L.B. Freund and S. Suresh: "Thin Film Materials"
Course: Mechanics of Laminated Composites [T-MACH-108717]

**Responsible:** Prof. Dr. Eckart Schnack  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102607 - Major Field: Vehicle Technology  
M-MACH-102611 - Major Field: Materials Science and Engineering  
M-MACH-102628 - Major Field: Lightweight Construction

<table>
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**Exams**

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<td>2 SWS</td>
<td>Lecture / 🗣</td>
<td>Schnack</td>
</tr>
</tbody>
</table>

**Competence Certificate**  
Oral exam, approx. 20 minutes

**Prerequisites**  
none

**Annotation**  
The lecture notes are made available via ILIAS.

---

**Below you will find excerpts from events related to this course:**

**Mechanics of laminated composites**  
2161983, WS 21/22, 2 SWS, Language: German, [Open in study portal]

**Content**  
Definition of composites, definition of static and kinematic groups. Definition of material laws. Transformation of the state values of composites and transformation of the material properties for the coordinate systems in the design of machine structures.

**Organizational issues**  
Beginn ab 09.11.2021
10.282 Course: Medical Imaging Techniques I [T-ETIT-101930]

**Responsible:** Prof. Dr. Olaf Dössel

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:**
- M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering
- M-MACH-102615 - Major Field: Medical Technology

**Type**
- Written examination

**Credits**
- 3

**Grading scale**
- Grade to a third

**Recurrence**
- Each winter term

**Version**
- 1

**Events**

| WT 21/22 | 2305261 | Medical Imaging Techniques I | 2 SWS | Lecture | Dössel |

**Competence Certificate**
Success control is carried out in the form of a written test of 120 minutes.

**Prerequisites**
none
10.283 Course: Medical Imaging Techniques II [T-ETIT-101931]

**Responsible:** Prof. Dr. Olaf Dössel  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:**  
M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering  
M-MACH-102615 - Major Field: Medical Technology

<table>
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<td>Each summer term</td>
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**Events**

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<th>Lecture</th>
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<td>Medical Imaging Techniques II</td>
<td>Lecture / 🖥</td>
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**Exams**

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<td>Dössel</td>
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</table>

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), ⏯ On-Site, ☑ Cancelled

**Competence Certificate**
Success control is carried out in the form of a written test of 120 minutes.

**Prerequisites**
none

**Recommendation**
The contents of the M-ETIT-100384 module are required.
### Course: Medical Robotics [T-INFO-101357]

**Responsible:** Prof. Dr.-Ing. Torsten Kröger  
Jun.-Prof. Dr. Franziska Mathis-Ullrich

**Organisation:** KIT Department of Informatics

**Part of:** M-MACH-102615 - Major Field: Medical Technology

<table>
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**Events**

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**Exams**

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<td>Mathis-Ullrich</td>
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</tbody>
</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
10.285 Course: Metal Forming [T-MACH-105177]

**Responsible:** Dr. Thomas Herlan

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102618 - Major Field: Production Technology

**Type:** Oral examination

**Credits:** 4

**Grading scale:** Grade to a third

**Recurrence:** Each summer term

**Version:** 2

<table>
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<tr>
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<td>Metal Forming</td>
<td>2 SWS</td>
<td>Lecture / Online</td>
<td>Herlan</td>
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<td>Metal Forming</td>
<td></td>
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<td>Herlan</td>
</tr>
</tbody>
</table>

**Competence Certificate**
- Oral Exam (20 min)

**Prerequisites**
- none

Below you will find excerpts from events related to this course:

<table>
<thead>
<tr>
<th>Lecture (V)</th>
<th>Online</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal Forming</td>
<td>2150681, SS 2021, 2 SWS, Language: German, <a href="#">Open in study portal</a></td>
</tr>
</tbody>
</table>
Content
At the beginning of the lecture the basics of metal forming are briefly introduced. The focus of the lecture is on massive forming (forging, extrusion, rolling) and sheet forming (car body forming, deep drawing, stretch drawing). This includes the systematic treatment of the appropriate metal forming Machines and the corresponding tool technology. Aspects of tribology, as well as basics in material science and aspects of production planning are also discussed briefly. The plastic theory is presented to the extent necessary in order to present the numerical simulation method and the FEM computation of forming processes or tool design. The lecture will be completed by product samples from the forming technology.

The topics are as follows:

- Introduction and basics
- Hot forming
- Metal forming machines
- Tools
- Metallographic fundamentals
- Plastic theory
- Tribology
- Sheet forming
- Extrusion
- Numerical simulation

Learning Outcomes:
The students …

- are able to reflect the basics, forming processes, tools, Machines and equipment of metal forming in an integrated and systematic way.
- are capable to illustrate the differences between the forming processes, tools, machines and equipment with concrete examples and are qualified to analyze and assess them in terms of their suitability for the particular application.
- are also able to transfer and apply the acquired knowledge to other metal forming problems.

Workload:
regular attendance: 21 hours
self-study: 99 hours

Organizational issues
Vorlesungstermine freitags, wöchentlich.
Die konkreten Termine werden in der ersten Vorlesung bekannt gegeben und auf der Institutshomepage und ILIAS veröffentlicht.

Literature
Medien:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)
# Metallographic Lab Class [T-MACH-105447]

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier
Fabian Mühl

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102591 - Laboratory Course
M-MACH-102611 - Major Field: Materials Science and Engineering

<table>
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<th>Type</th>
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<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
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**Events**

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<td>ST 2021</td>
<td>2175590</td>
<td>Metallographic Lab Class</td>
<td>3</td>
<td>Practical course</td>
<td>Heilmaier, Mühl</td>
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<tr>
<td>WT 21/22</td>
<td>2175590</td>
<td>Metallographic Lab Class</td>
<td>3</td>
<td>Practical course</td>
<td>Mühl, Kauffmann</td>
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</table>

**Exams**

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<tr>
<th>Event Code</th>
<th>Code</th>
<th>Type</th>
<th>SWS</th>
<th>Grading</th>
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<tbody>
<tr>
<td>ST 2021</td>
<td>76-T-MACH-105447</td>
<td>Metallographic Lab Class</td>
<td></td>
<td></td>
<td>Heilmaier</td>
</tr>
</tbody>
</table>

**Competence Certificate**

Colloquium for every experiment, about 60 minutes, protocol

**Prerequisites**

none

Below you will find excerpts from events related to this course:

## Metallographic Lab Class

2175590, SS 2021, 3 SWS, Language: German, Open in study portal

**Practical course** (P)

**On-Site**

**Content**

**Organizational issues**

Anmeldung erforderlich, per Mail an fabian.muehl@kit.edu mit Angaben zu: Name, Immatrikulations-Nr., Studiengang, Semester, Anrechnung als Fachpraktikum, Laborpraktikum oder Schwerpunkt.
!!!! Aufgrund der ungewissen Ausgangslage ist das Format des Praktikums abhängig von der Corona-Verordnung. Voraussichtlich wird das Praktikum in der folgenden Version stattfinden:


Die angemeldeten Teilnehmer werden zu einem ILIAS-Kurs eingeladen und für weitere Details (Zeitplan etc.) kontaktiert.

**Literature**

Macherauch, E.: Praktikum in Werkstoffkunde, 10. Aufl., 1992


Literaturliste wird zu jedem Versuch ausgegeben
**Content**
Light microscope in metallography
metallographic sections of metallic materials
Investigation of the microstructure of unalloyed steels and cast iron
Microstructure development of steels with accelerated cooling from the austenite area
Investigation of microstructures of alloyed steels
Investigation of failures quantitative microstructural analysis
Microstructural investigation of technically relevant non-ferrous metals
Application of Scanning electron microscope

**learning objectives:**
The students in this lab class gain are able to perform standard metallographic preparations and are able to apply standard software for quantitative microstructural analyses. Based on this the student can interpret unetched as well as etched microstructures with respect to relevant microstructural features. They can draw concluding correlations between heat treatments, ensuing microstructures and the resulting mechanical as well as physical properties of the investigated materials.

**requirements:**
Material Science I/II

**workload:**
The workload for the Metallographic Lab Class is 120 h per semester and consists of the presence during the lab course (25 h) as well as preparation and rework time at home (95 h).

**Organizational issues**
Anmeldung erforderlich, per Mail an fabian.muehl@kit.edu mit Angaben zu: Name, Immatrikulations-Nr., Studiengang, Semester, Anrechnung als Fachpraktikum, Laborpraktikum oder Schwerpunkt.
Der praktische Teil des Praktikums wird an 5 Terminen im Dezember und Januar in Kleingruppen unter Einhaltung der 3G-Regel stattfinden. Die Anwesenheit ist an allen 5 Terminen verpflichtend.
Die einzelnen Termine werden jeweils auf einen Dienstag oder Freitag Vormittag terminiert, wobei die Terminfindung nach Anmeldeschluss in enger Absprache mit den Studenten stattfinden wird. Die Dauer wird 4-5 Stunden pro Übungstag betragen.
Die angemeldeten Teilnehmer werden zu einem ILIAS-Kurs eingeladen und für weitere Details (Zeitplan etc.) kontaktiert.

**Literature**
Macherauch, E.: Praktikum in Werkstoffkunde, 10. Aufl., 1992

Literaturliste wird zu jedem Versuch ausgegeben
10.287 Course: Metals [T-MACH-105468]

**Responsible:** Prof. Dr.-Ing. Martin Heilmair  
Prof. Dr. Astrid Pundt

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

<table>
<thead>
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<th>Credits</th>
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<tr>
<td>Oral exam</td>
<td>6</td>
<td>Grade to a third</td>
<td>Each summer term</td>
<td>1</td>
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**Events**

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<tr>
<th>Event</th>
<th>Code</th>
<th>Type</th>
<th>Credits</th>
<th>Grading</th>
<th>Recurrence</th>
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<tr>
<td>ST 2021</td>
<td>2174598</td>
<td>Metals</td>
<td>4 SWS</td>
<td>Lecture / 🗣️</td>
<td>Pundt, Kauffmann</td>
<td></td>
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<tr>
<td>ST 2021</td>
<td>2174599</td>
<td>Exercises in Metals</td>
<td>1 SWS</td>
<td>Practice / 🖥️</td>
<td>Pundt, Kauffmann</td>
<td></td>
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</tbody>
</table>

Legend: 🗣️ Online, 📦 Blended (On-Site/Online), 📚 On-Site, ✗ Cancelled

**Competence Certificate**

Oral exam, about 20 minutes

**Prerequisites**

none

**Below you will find excerpts from events related to this course:**

### Metals

<table>
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<tr>
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<th>Recurrence</th>
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<tbody>
<tr>
<td>2174598</td>
<td>Lecture (V)</td>
<td>Blended (On-Site/Online)</td>
<td></td>
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</table>

**Content**

Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

**Learning objectives:**

The students are familiar with the thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid state, the mechanisms of microstructure formation and microstructure-property relationships and can apply them to metallic materials. They can assess the effects of heat treatments and of alloying on the microstructure and the mechanical and physical properties of metallic materials. This competence is in particular deepened for iron- and aluminum-based alloys.

**Requirements:**

Materials physics

**Workload:**

Regular attendance: 42 h
Self-study: 138 h

**Organizational Issues**


Die Vorlesung wird zu den angegebenen Zeiten online stattfinden. Bitte melden Sie sich für eine Teilnahme in ILIAS an.

**Literature**

G. Gottstein, Physikalische Grundlagen der Materialkunde, Springer 2007
E. Hombogen, H. Warlimont, Metalle (Struktur und Eigenschaften von Metallen und Legierungen), Springer-Verlag, Berlin 2001
H.-J. Bargel, G. Schulze, Werkstoffkunde, Springer-Verlag Berlin 2005
J. Freudenberger: [http://www.ifw-dresden.de/institutes/imw/lectures/lectures/pwe](http://www.ifw-dresden.de/institutes/imw/lectures/lectures/pwe)

### Exercises in Metals

<table>
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<tr>
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**Content**

Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

**Learning objectives:**

The students are familiar with the thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid state, the mechanisms of microstructure formation and microstructure-property relationships and can apply them to metallic materials. They can assess the effects of heat treatments and of alloying on the microstructure and the mechanical and physical properties of metallic materials. This competence is in particular deepened for iron- and aluminum-based alloys.

**Requirements:**

Materials physics

**Workload:**

Regular attendance: 42 h
Self-study: 138 h

**Organizational Issues**


Die Vorlesung wird zu den angegebenen Zeiten online stattfinden. Bitte melden Sie sich für eine Teilnahme in ILIAS an.

**Literature**

G. Gottstein, Physikalische Grundlagen der Materialkunde, Springer 2007
E. Hombogen, H. Warlimont, Metalle (Struktur und Eigenschaften von Metallen und Legierungen), Springer-Verlag, Berlin 2001
H.-J. Bargel, G. Schulze, Werkstoffkunde, Springer-Verlag Berlin 2005
J. Freudenberger: [http://www.ifw-dresden.de/institutes/imw/lectures/lectures/pwe](http://www.ifw-dresden.de/institutes/imw/lectures/lectures/pwe)
Content
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

learning objectives:
The Students have hands-on experience in the application of thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid state, the mechanisms of microstructure formation and microstructure-property relationships. They can assess the effects of heat treatments and of alloying on the microstructure and the mechanisms and physical properties of metallic materials. This competence is in particular practiced for iron- and aluminum-based alloys.

requirements:
Materials physics

workload:
Regular attendance: 14 h
Self-study: 16 h

Organizational issues
Weitere Informationen finden Sie hier: https://www.iam.kit.edu/wk/lehre.php

Literature
http://dx.doi.org/10.1007/978-3-642-36603-1 (frei über die KIT-Lizenz abrufbar)
http://www.ifw-dresden.de/institutes/imw/lectures/pwe
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC309606810
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC27759961X
http://dx.doi.org/10.1007/978-3-662-47952-0 (frei über die KIT-Lizenz abrufbar)
http://dx.doi.org/10.1007/978-3-662-22561-1 (frei über die KIT-Lizenz abrufbar)
http://dx.doi.org/10.1007/978-3-642-17717-0 (frei über die KIT-Lizenz abrufbar)
http://dx.doi.org/10.1007/978-3-658-13795-3 (frei über die KIT-Lizenz abrufbar)
10.288 Course: Methods and Processes of PGE - Product Generation Development [T-MACH-109192]

**Responsible:** Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Norbert Burkardt
Prof. Dr.-Ing. Sven Matthiesen

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102718 - Product Development - Methods of Product Development

<table>
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<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<td>Each summer term</td>
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**Events**

<table>
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<tr>
<th>Session</th>
<th>Course ID</th>
<th>Course Title</th>
<th>SWS</th>
<th>Type</th>
<th>Credit</th>
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<th>Instructor</th>
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<tbody>
<tr>
<td>ST 2021</td>
<td>2146176</td>
<td>Methods and processes of PGE - Product Generation Development</td>
<td>4</td>
<td>Lecture / Online</td>
<td>6</td>
<td>Grade to a third</td>
<td>Each summer term</td>
<td>Albers</td>
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**Exams**

<table>
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<th>Course ID</th>
<th>Course Title</th>
<th>SWS</th>
<th>Type</th>
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<td>Each summer term</td>
<td>Albers</td>
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<td>76-T-MACH-105382-en</td>
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<td>Each summer term</td>
<td>Albers</td>
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<td>WT 21/22</td>
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<td>Methods and Processes of PGE - Product Generation Engineering</td>
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<td>Each summer term</td>
<td>Albers, Burkardt</td>
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<td>76-T-MACH-105382-en</td>
<td>Methods and Processes of PGE - Product Generation Engineering</td>
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<td></td>
<td>Each summer term</td>
<td>Albers</td>
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</tbody>
</table>

**Legend:**

- 🖥 Online
- 🧩 Blended (On-Site/Online)
- 🗣 On-Site
- 🔴 Cancelled

**Competence Certificate**

Written exam (processing time: 120 min + 10 min reading time)

**Auxiliaries:**

- Calculator
- German dictionary (books only)

**Prerequisites**

None

**Annotation**

This lecture is the basis for the main subject Integrated Product Development, which is offered as a specialisation.

**Below you will find excerpts from events related to this course:**

**Methods and processes of PGE - Product Generation Development**

2146176, SS 2021, 4 SWS, Language: German, Open in study portal
Content

Note:
This lecture is the basis for the main subject Integrated Product Development, which is offered as a specialisation.

Recommendations:
none

Workload:
regular attendance: 39 h
self-study: 141 h

Examination:
Written exam
Duration: 120 minutes (+10 minutes reading time)

Auxiliaries:
- Calculator
- German dictionary (books only)

Course content:
Basics of Product Development: Basic Terms, Classification of the Product
Development into the industrial environment, generation of costs / responsibility for costs
Concept Development: List of demands / Abstraction of the Problem Definition / Creativity Techniques / Evaluation and selection of solutions
Drafting: Prevailing basic rules of Design / Design Principles as a problem oriented accessory
Quality Assurance in early Development Phases: Methods of Quality Assurance in an overview/QFD/FMEA

Learning objectives:
The students are able to...
- classify product development in companies and differentiate between different types of product development.
- name the relevant influencing factors of a market for product development.
- name, compare and use the central methods and process models of product development within moderate complex technical systems.
- explain problem solving techniques and associated development methods.
- explain product profiles and to differentiate and choose suitable creative techniques of solution/idea generation finding on this basis.
- use design guidelines to create simple technical systems and to explain these guidelines.
- name and compare quality assurance methods; to choose and use suitable methods for particular applications.
- explain the different methods of design of experiment.
- explain the costs in development process.

Literature
Vorlesungsunterlagen
Pahl, Beitz: Konstruktionslehre, Springer-Verlag 1997
Hering, Triemel, Blank: Qualitätssicherung für Ingenieure; VDI-Verlag,1993
10.289 Course: Methods of Signal Processing [T-ETIT-100694]

**Responsible:** Prof. Dr.-Ing. Michael Heizmann

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

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**Events**

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<td>Lecture / 🧩</td>
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**Exams**

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ☑ Cancelled

**Prerequisites**

- none
10.290 Course: Micro- and nanotechnology in implant technology [T-MACH-111030]

Responsible: Dr. Patrick Wolfgang Doll
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

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<td>Each winter term</td>
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Competence Certificate
Oral Exam (20 min.)

Prerequisites
None
### 10.291 Course: Micro Magnetic Resonance [T-MACH-105782]

**Responsible:** Prof. Dr. Jan Gerrit Korvink  
Dr. Neil MacKinnon

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102616 - Major Field: Microsystem Technology  
M-MACH-102647 - Major Field: Microactuators and Microsensors

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**Events**

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<th>2141501</th>
<th>Micro Magnetic Resonance</th>
<th>2 SWS</th>
<th>Seminar / 🧩</th>
<th>MacKinnon, Badilita, Jouda, Korvink</th>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 📝 On-Site, ✗ Cancelled

**Competence Certificate**

Own Presentation, participation at the course discussions, result is passed or failed.

**Prerequisites**

none

---

Below you will find excerpts from events related to this course:

![Visual representation](image-url)
10.292 Course: Microactuators [T-MACH-101910]

Responsible: Prof. Dr. Manfred Kohl
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102616 - Major Field: Microsystem Technology
- M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools
- M-MACH-102647 - Major Field: Microactuators and Microsensors

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Events

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Exams

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<td>Microactuators</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ☑️ Cancelled

Competence Certificate
written exam, 60 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

Microactuators
2142881, SS 2021, 2 SWS, Language: German, Open in study portal

Content
- Basic knowledge in the material science of the actuation principles
- Layout and design optimization
- Fabrication technologies
- Selected developments
- Applications

The lecture includes amongst others the following topics:

- Microelectromechanical systems: linear actuators, microrelais, micromotors
- Medical technology and life sciences: Microvalves, micropumps, microfluidic systems
- Microrobotics: Microgrippers, polymer actuators (smart muscle)
- Information technology: Optical switches, mirror systems, read/write heads

Literature
- Folienskript "Mikroaktorik"
- M. Kohl, Shape Memory Microactuators, M. Kohl, Springer-Verlag Berlin, 2004
10.293 Course: Microenergy Technologies [T-MACH-105557]

**Responsible:** Prof. Dr. Manfred Kohl  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102598 - Major Field: Advanced Mechatronics  
- M-MACH-102614 - Major Field: Mechatronics  
- M-MACH-102616 - Major Field: Microsystem Technology  
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology  
- M-MACH-102647 - Major Field: Microactuators and Microsensors

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**Events**

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**Exams**

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<td>Grade to a third</td>
<td>Each summer term</td>
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**Competence Certificate**

Oral examination (30 Min.)

**Prerequisits**

none

**Below you will find excerpts from events related to this course:**

---

**Microenergy Technologies**

2142897, SS 2021, 2 SWS, Language: English, Open in study portal

**Content**

- Basic physical principles of energy conversion  
- Layout and design optimization  
- Technologies  
- Selected devices  
- Applications

The lecture includes amongst others the following topics:  
- Micro energy harvesting of vibrations  
- Thermal micro energy harvesting  
- Microtechnical applications of energy harvesting  
- Heat pumps in micro technology  
- Micro cooling

**Literature**

- Folienskript "Micro Energy Technologies"  
Responsible: Dr. Patric Gruber
Prof. Dr. Oliver Kraft

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

Type: Oral examination
Credits: 6
Grading scale: Grade to a third
Recurrence: Each summer term
Version: 1

Events

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<td>3 SWS</td>
<td>Lecture / 📚</td>
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<td>ST 2021</td>
<td>Exercices in Microstructure-Property-Relationships</td>
<td>1 SWS</td>
<td>Practice / 📚</td>
<td>Kirchlechner, Wagner, Gruber</td>
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Legend: 📚 Online, 📚 Blended (On-Site/Online), 🗣 On-Site, ☐ Canceled

Competence Certificate
oral exam, 30 min

Prerequisites
none

Below you will find excerpts from events related to this course:

Microstructure-Property-Relationships
2178124, SS 2021, 3 SWS, Language: German, Open in study portal

Content
The following microstructure-property-relationships will be discussed for all material classes:
- Elasticity and plasticity
- Fracture mechanics
- Fatigue
- Creep
- 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
Die Vorlesung wird unabhängig von den zuvor angekündigten Vorlesungsterminen angeboten. Dazu werden die Vorlesungsfolien mit Tonspur und Tafelaufschrieben als Video via ILIAS verteilt. Zudem werden die Vorlesungsfolien auf ILIAS bereitgestellt. Weitere Informationen zur Interaktion werden ebenfalls über ILIAS bekanntgegeben. Bei Fragen wenden Sie sich bitte jederzeit an christoph.kichlechner@kit.edu oder patric.gruber@kit.edu.

Der Kursbeitritt in ILIAS erfolgt selbstständig.
Content
Exercise course for the lecture Microstructure-Property-Relationships LV Nr. 2178124.

Organizational issues
Die Übung wird unabhängig von den zuvor angekündigten Übungsterminen angeboten. Dazu werden die Übungsaufgaben mit Tonspur und Tafelaufschriften als Video via ILIAS verteilt. Weitere Informationen zur Interaktion werden ebenfalls über ILIAS bekanntgegeben. Bei Fragen wenden Sie sich bitte jederzeit an christoph.kichlechner@kit.edu oder patric.gruber@kit.edu. Der Kursbeitritt in ILIAS erfolgt selbstständig.
### Course: Microsystem product design for young entrepreneurs [T-MACH-105814]

**Responsible:** Prof. Dr. Jan Gerrit Korvink  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102616 - Major Field: Microsystem Technology

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#### Events

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

The class is a laboratory course that is taken in groups, hence the active and productive participation in the team effort is evaluated. To check the individual performance, there will be weekly discussions about the project. To evaluate each group's progress, there will be 2 presentation during the duration of the course. The final mark is determined from the marks obtained in the presentation and an oral group examination of 1 hour.

**Prerequisites**

none
10.296 Course: Microsystem Simulation [T-MACH-108383]

**Responsible:** Prof. Dr. Jan Gerrit Korvink

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102616 - Major Field: Microsystem Technology

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**Competence Certificate**
written exam

**Prerequisites**
one
### 10.297 Course: Miniaturized Heat Exchangers [T-MACH-108613]

**Responsible:** Prof. Dr.-Ing. Jürgen Brandner  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102616 - Major Field: Microsystem Technology

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ☠ Cancelled

**Competence Certificate**
oral exam, 20 min.

**Prerequisites**
none
### 10.298 Course: Mobile Computing and Internet of Things [T-INFO-102061]

**Responsible:** Prof. Dr.-Ing. Michael Beigl  
**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

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10.299 Course: Mobile Machines [T-MACH-105168]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102630 - Major Field: Mobile Machines

<table>
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Competence Certificate
The assessment consists of an oral exam (45 min) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Prerequisites
none

Recommendation
Knowledge in Fluid Power Systems is required. It is recommended to attend the course Fluid Power Systems [2114093] beforehand.

Annotation
After completion of the course the students have knowledge of:

- a wide range of mobile machines
- operation modes and working cycles of important mobile machines
- selected subsystems and components

Content:

- Introduction of the required components and machines
- Basics and structure of mobile machines
- Practical insight in the development techniques

Below you will find excerpts from events related to this course:

Mobile Machines
2114073, SS 2021, 4 SWS, Language: German, Open in study portal

Content

- Introduction of the required components and machines
- Basics of the structure of the whole system
- Practical insight in the development techniques

Knowledge in Fluid Power is required.

Recommendations:
It is recommended to attend the course Fluid Power Systems [2114093] beforehand.

- regular attendance: 42 hours
- self-study: 184 hours
Course: Model Based Application Methods [T-MACH-102199]

10.300 Course: Model Based Application Methods [T-MACH-102199]

**Responsible:** Dr. Frank Kirschbaum  
**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

**Type**  
Oral examination

**Credits**  
4

**Grading scale**  
Grade to a third

**Recurrence**  
Each summer term

**Version**  
1

**Competence Certificate**  
take-home exam, short presentation with oral examination

**Prerequisites**  
none
10.301 Course: Modeling and Simulation [T-MACH-105297]

**Responsible:** Prof. Dr.-Ing. Kai Furmans  
Prof. Dr.-Ing. Marcus Geimer  
Dr. Balázs Pritz  
Prof. Dr.-Ing. Carsten Proppe

**Organisation:** KIT Department of Mechanical Engineering

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**Part of:** M-MACH-102592 - Modeling and Simulation

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**Events**

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<td>Modelling and Simulation</td>
<td>2 SWS</td>
<td>Lecture / 🛑</td>
<td>Proppe, Furmans, Pritz, Geimer</td>
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<td>WT 21/22</td>
<td>2185228</td>
<td>Übungen zu Modellbildung und Simulation</td>
<td>2 SWS</td>
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**Exams**

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**Legend:** 🛑 Online, 🛑 Blended (On-Site/Online), 🎤 On-Site, 🗑 Cancelled

**Competence Certificate**
The assessment consists of a 180 minutes written examination.

**Prerequisites**
none

**Below you will find excerpts from events related to this course:**

**Modelling and Simulation**  
2185227, WS 21/22, 2 SWS, Language: German, Open in study portal

**Lecture (V) Online**

**Content**
Introduction: Overview, concept formation, simulation studies, time/event-discrete models, event-oriented/process orientated/transaction-oriented view, typical model classes (operation/maintenance, storekeeping, loss-susceptible systems)

Time-continuous models with concentrated parameters, model characteristics and model analysis Numerical treatment of ordinary differential equations and differential-algebraic sets of equations coupled simulations with concentrated parameters

Time-continuous models with distributed parameters, description of systems by means of partial differential equations, model reduction, numerical solution procedures for partial differential equations

**Literature**
Keine.
10 COURSES

Course: Modeling of Thermodynamical Processes [T-MACH-105396]

10.302 Course: Modeling of Thermodynamical Processes [T-MACH-105396]

Responsible:
Prof. Dr. Ulrich Maas
Dr.-Ing. Robert Schießl

Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102635 - Major Field: Engineering Thermodynamics
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

Type: Oral examination
Credits: 6
Grading scale: Grade to a third
Recurrence: Each term
Version: 1

Events

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<th>Grading</th>
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Exams

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Legend: 🖥️ Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, ❌ Cancelled

Competence Certificate

Oral exam, approx. 30 min

Prerequisites

none

Below you will find excerpts from events related to this course:

**V** Modeling of Thermodynamical Processes
2167523, SS 2021, 3 SWS, Language: German, [Open in study portal]

**V** Modeling of Thermodynamical Processes
2167523, WS 21/22, 3 SWS, Language: German, [Open in study portal]

**Content**

Thermodynamic basics
Numerical solver strategies for algebraic equations
Optimization issues

Ordinary and partial differential equations
Application to various problems in thermodynamics (engine processes, determination of equilibrium states, unsteady processes in inhomogeneous systems)

**Literature**

Vorlesungsskript
Numerical Recipes C, FORTRAN; Cambridge University Press
R.W. Hamming; Numerical Methods for scientists and engineers; Dover Books On Engineering; 2nd edition; 1973
J. Kopitz, W. Polifke; Wärmeübertragung; Pearson Studium; 1. Auflage

**Content**

Principles of modelling; Representation of physical systems by equations
Numerical solution strategies for nonlinear equation systems
Constrained Optimization
Ordinary and partial differential equations
Application to various problems in thermodynamics (engine processes, determination of equilibrium states, unsteady processes in inhomogeneous systems)
Literature

Vorlesungsskript

Numerical Recipes C, FORTRAN; Cambridge University Press
R.W. Hamming; Numerical Methods for scientists and engineers; Dover Books On Engineering; 2nd edition; 1973
J. Kopitz, W. Polifke; Wärmeübertragung; Pearson Studium; 1. Auflage
## 10.303 Course: Modeling of Turbulent Flows - RANS and LES [T-BGU-110842]

**Responsible:** Prof. Dr.-Ing. Markus Uhlmann  
**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences  
**Part of:** M-MACH-102634 - Major Field: Fluid Mechanic

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### Exams

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**  
oral exam, appr. 45 min.

**Prerequisites**  
one

**Recommendation**  
one

**Annotation**  
one
10.304 Course: Modelling and Simulation [T-MACH-100300]

**Responsible:**  
Prof. Dr. Peter Gumbsch  
Prof. Dr. Britta Nestler

**Organisation:**  
KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering  
M-MACH-102742 - Fundamentals and Methods of Production Technology  
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering  
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

**Type**  
Written examination

**Credits**  
5

**Grading scale**  
Grade to a third

**Recurrence**  
Each term

**Version**  
2

### Events

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### Exams

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**Competence Certificate**  
Written exam, 90 min

**Prerequisites**  
none

**Recommendation**  
preliminary knowledge in mathematics, physics and materials science

**Below you will find excerpts from events related to this course:**

### Modelling and Simulation

2183703, SS 2021, 2+1 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
Online
Content
The course gives an introduction to modelling and simulation techniques.
The following topics are included:
- splines, interpolation methods, Taylor series
- finite difference method
- dynamical systems
- numerics of partial differential equations
- mass and heat diffusion
- microstructure simulation
- parallel and adaptive algorithms
- high performance computing
- practical exercises

The student can

• explain the basic algorithms and numerical methods which are beside other applications relevant for materials simulations.
• describe and apply numerical solution methods for partial differential equations and dynamical systems
• apply numerical methods to solve heat and mass diffusion problems which can also be used to model microstructure formation processes
• has experiences in how to implement and program the introduced numerical methods from an integrated computer lab.

preliminary knowledge in mathematics, physics and materials science recommended
regular attendance: 22.5 hours lecture, 11.5 hours exercises
self-study: 116 hours

We regularly hand out exercise sheets. In addition, the course will be accompanied by practical exercises at the computer.
written examination: 90 minutes

Organizational issues
Die Termine für die Übungen werden in der Vorlesung und im Ilias bekannt gegeben.

Literature
Literature

10.305 Course: Modelling of Microstructures [T-MACH-105303]

**Responsible:** Dr. Anastasia August  
Prof. Dr. Britta Nestler

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102611 - Major Field: Materials Science and Engineering
- M-MACH-102646 - Major Field: Applied Mechanics
- M-MACH-102647 - Major Field: Microactuators and Microsensors
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
- M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

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<td>Each winter term</td>
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**Events**

**WT 21/22**
- 2183702 Modelling of Microstructures 3 SWS Lecture / Practice (Online) August, Nestler

**Exams**

**ST 2021**
- 76-T-MACH-105303 Modelling of Microstructures August, Nestler, Weygand

**WT 21/22**
- 76-T-MACH-105303 Modelling of Microstructures August, Nestler, Weygand

**Legend:** Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**
oral exam 30 min

**Prerequisites**
none

**Recommendation**
materials science  
fundamental mathematics

Below you will find excerpts from events related to this course:

**Modelling of Microstructures**
- 2183702, WS 21/22, 3 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
- Online
## Content

- Brief Introduction in thermodynamics
- Statistical interpretation of entropy
- Gibbs free energy and phase diagrams
- Free energy functional
- Phasefield equation
- Gibbs-Thomson-equation
- Driving forces
- Grand chemical potential functional and the evolution equations
- For compare: Free energy functional with driving forces

The student can

- explain the thermodynamic and statistical foundations for liquid-solid and solid-solid phase transition processes and apply them to construct phase diagrams.
- describe the specific characteristics of dendritic, eutectic and peritectic microstructures.
- explain the mechanisms of grain and phase boundary motion induced by external fields
- use the phase-field method for simulation of microstructure formation processes using modeling approaches and challenges of current research
- has experiences in computing and conduction simulations of microstructure formation from an integrated computer lab.

Knowledge in materials science and in fundamental mathematics recommended

Regular attendance: 22.5 hours lecture, 11.5 hours exercises
Self-study: 116 hours

We regularly hand out exercise sheets. The individual solutions will be corrected.

Oral exam ca. 30 min

## Literature

4. Gaskell, D.R., Introduction to the thermodynamics of materials
5. Übungsläitter
10 COURSES

Course: Modern Control Concepts I [T-MACH-105539]

Responsible: apl. Prof. Dr. Lutz Groell
apl. Prof. Dr. Jörg Matthes

Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102601 - Major Field: Automation Technology
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102633 - Major Field: Robotics

Type
Written examination

Credits
4

Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events

ST 2021 2105024 Modern Control Concepts I 2 SWS Lecture / 🖥 Matthes, Groell
ST 2021 2106020 Tutorial on Modern Control Concepts I 2 SWS Practice / 🖥 Matthes

Exams

ST 2021 76-T-MACH-105539 Modern Control Concepts I Matthes
WT 21/22 76-T-MACH-105539 Modern Control Concepts I Matthes

Competence Certificate
Written exam (Duration: 1 h)

Prerequisites
none

Below you will find excerpts from events related to this course:

Modern Control Concepts I
2105024, SS 2021, 2 SWS, Language: German, Open in study portal

Tutorial on Modern Control Concepts I
2106020, SS 2021, 2 SWS, Language: German, Open in study portal

Literature

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. Concept 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 recommended:

- Grundlagen der Mess- und Regelungstechnik

Alternatively: Comparable courses of the faculty of electrical engineering

Literature

10.307 Course: Modern Control Concepts II [T-MACH-106691]

Responsible: apl. Prof. Dr. Lutz Groell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102598 - Major Field: Advanced Mechatronics
         M-MACH-102601 - Major Field: Automation Technology

Type: Oral examination
Credits: 4
Grading scale: Grade to a third
Recurrence: Each winter term
Version: 1

Events
WT 21/22  2106032  Modern Control Concepts II  2 SWS  Lecture / 🗣  Groell

Exams
ST 2021  76-T-MACH-106691  Modern Control Concepts II  Groell

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🗑 Cancelled

Competence Certificate
oral exam (Duration: 30min)

Prerequisites
none

Below you will find excerpts from events related to this course:

Modern Control Concepts II
2106032, WS 21/22, 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
- Skogestad, S., Postlethwaite, I.: Multivariable Feedback Control, 2001
10.308 Course: Modern Control Concepts III [T-MACH-106692]

Responsible:  apl. Prof. Dr. Lutz Groell
Organisation:  KIT Department of Mechanical Engineering

Part of:  M-MACH-102598 - Major Field: Advanced Mechatronics  
M-MACH-102601 - Major Field: Automation Technology

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Exams

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Legend:  🖥 Online,  🧩 Blended (On-Site/Online), 🗣 On-Site, 🗙 Cancelled

Competence Certificate
oral exam (Duration: 30min)

Prerequisites
none

Below you will find excerpts from events related to this course:

Modern Control Concepts III
2106035, SS 2021, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

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.
10.309 Course: Motor Vehicle Labor [T-MACH-105222]

Responsible: Dr.-Ing. Michael Frey
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course

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Events

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Exams

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Competence Certificate
Colloquium before each experiment
After completion of the experiments: written examination
Duration: 90 minutes
Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

Motor Vehicle Laboratory
2115808, SS 2021, 2 SWS, Language: German, Open in study portal

Content
1. Determination of the driving resistances of a passenger vehicle on a roller dynamometer; measurement of the engine performance of the test vehicle
2. Investigation of a twin-tube and a single-tube shock absorber
3. Behavior of car tyres under longitudinal forces and lateral forces
4. Behavior of car tires on wet road surface
5. Rolling resistance, energy dissipation and high-speed strength of car tires
6. Investigation of the moment transient characteristic of a Visco clutch

Learning Objectives:
The students have deepened their knowledge on motor vehicles acquired in lectures and can apply it practically. They have an overview of the applied measuring technique and can execute and analyse measurements for the handling of given problem definitions. They are ready to analyze and to judge measurement results.
Organizational issues
Genauer Ort und Termine sowie weitere Infos siehe Institutshomepage.

Einteilung in
- Gruppe A: Mo 14:00 - 15:30
- Gruppe B: Mo 16:00 - 17:30
- Gruppe C: Di 09:00 - 10:30
- Gruppe D: Di 11:00 - 12:30
- Gruppe E: Di 14:00 - 15:30
- Gruppe F: Di 16:00 - 17:30

Literatur

Motor Vehicle Laboratory
2115808, WS 21/22, 2 SWS, Language: German, Open in study portal

Content
1. Determination of the driving resistances of a passenger vehicle on a roller dynamometer; measurement of the engine performance of the test vehicle
2. Investigation of a twin-tube and a single-tube shock absorber
3. Behavior of car tyres under longitudinal forces and lateral forces
4. Investigation of acoustic behaviour of vehicles
5. Rolling resistance, energy dissipation and high-speed strength of car tires
6. Investigation of the moment transient characteristic of a Visco clutch

Learning Objectives:
The students have deepened their knowledge on motor vehicles acquired in lectures and can apply it practically. They have an overview of the applied measuring technique and can execute and analyse measurements for the handling of given problem definitions. They are ready to analyze and to judge measurement results.

Organizational issues
Genaue Termine und weitere Hinweise: siehe Institutshomepage.

Einteilung:
Gruppe A: Mo 14:00-15:30
Gruppe B: Mo 16:00-17:30
Gruppe C: Di 09:00-10:30
Gruppe D: Di 11:00-12:30
Gruppe E: Di 14:00-15:30
Gruppe F: Di 16:00-17:30

Literatur
10.310 Course: Multi-Scale Plasticity [T-MACH-105516]

**Responsible:** Prof. Dr. Christian Greiner  
Dr. Katrin Schulz

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering  
M-MACH-102611 - Major Field: Materials Science and Engineering

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<td>Grade to a third</td>
<td>Each winter term</td>
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**Events**

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<td>Lecture / 📚</td>
<td>Greiner, Schulz</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

presentation (40%) und colloquium (30 min, 60%)

**Prerequisites**

none

**Recommendation**

preliminary knowledge in mathematics, physics, mechanics and materials science

**Annotation**

- limited number of participants  
- mandatory registration  
- mandatory attendance

**Below you will find excerpts from events related to this course:**

**Multi-scale Plasticity**  
2181750, WS 21/22, 2 SWS, Language: German, Open in study portal  
Lecture (V)  
Blended (On-Site/Online)

**Content**

This module will attempt to provide an overview to complex subjects in the field of material mechanics. For this purpose important scientific papers will be presented and discussed. This will be done by having students read and critique one paper each week in a short review. In addition, each week will include presentation from one of the participants which aim to advocate or criticise each piece of work using the short reviews. He will also be the discussion leader, while students discuss the content, ideas, evaluation and open research questions of the paper. Using a professional conference management system (HotCRP), the student assume the role of reviewers and gain insight into the work of researchers.

The student

- can explain the physical foundations of plasticity as well as results of latest research.  
- can independently read and evaluate scientific research papers.  
- can present specific, technical information in structured, precise, and readable manner.  
- is able to argue for and/or against a particular approach or idea using the knowledge acquired within the lecture.

preliminary knowledge in mathematics, physics, mechanics and materials science recommended

regular attendance: 22.5 hours  
self-study: 97.5 hours

Exam: presentation (40%), oral examination (30 min, 60%)

The maximum number of students is 14 per semester.
Organizational issues
Termine werden bekannt gegeben. Seminarraum des IAM-CMS (Geb. 10.91, Raum 227/3) Anmeldung per Email an katrin.schulz@kit.edu bis zum 08.10.2021
Course: Nanotechnology for Engineers and Natural Scientists [T-MACH-105180]

Responsible: Prof. Dr. Martin Dienwiebel
              apl. Prof. Dr. Hendrik Hölscher
              Stefan Walheim

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
         M-MACH-102616 - Major Field: Microsystem Technology
         M-MACH-102637 - Major Field: Tribology
         M-MACH-102647 - Major Field: Microactuators and Microsensors

Type
Written examination

Credits
4

Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events

ST 2021 2142861 Nanotechnology for Engineers and Natural Scientists 2 SWS Lecture / 🖥 Hölscher

Exams

ST 2021 76-T-MACH-105180 Nanotechnology for Engineers and Natural Scientists Hölscher
WT 21/22 76-T-MACH-105180 Nanotechnology for Engineers and Natural Scientists Hölscher, Dienwiebel

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🌐 On-Site, 🗑 Cancelled

Competence Certificate
written exam 90 min

Prerequisites
none

Below you will find excerpts from events related to this course:

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
Für die mündlichen Prüfungen werden zwei Termine angeboten werden (voraussichtlich in der ersten Woche nach Vorlesungsende im Sommersemester und in der ersten Woche vor Vorlesungsbeginn im Wintersemester).

Literature
Alle Folien und Originalliteratur werden auf ILIAS zur Verfügung gestellt.

Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021
Module Handbook, valid from Winter Term 2021/2022
10.312 Course: Nanotribology and -Mechanics [T-MACH-102167]

Responsible: Prof. Dr. Martin Dienwiebel
apl. Prof. Dr. Hendrik Hölscher

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102637 - Major Field: Tribology

Type: Examination of another type
Credits: 4
Grading scale: Grade to a third
Recurrence: Each summer term
Version: 4

Events

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Exams

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<td>Dienwiebel</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
presentation (40%) and colloquium (30 min, 60%)

no tools or reference materials

Prerequisites
none

Recommendation
preliminary knowledge in mathematics and physics

Below you will find excerpts from events related to this course:

V Nanotribology and -Mechanics
2182712, SS 2021, 2 SWS, Language: German, Open in study portal
Content
In the summer semester the lecture is offered in German and in the winter semester in English!

Part 1: Fundamentals of nanotribology

- General tribology / nanotechnology
- Forces and dissipation on the nanometer scale
- Experimental methods (SFA, QCM, FFM)
- Prandtl-Tomlinson model
- Superlubricity
- Carbon-based tribosystems
- Electronic friction
- Nanotribology in liquids
- Atomic abrasion
- nanolubrication

Part 2: Topical papers

The student can

- explain the physical foundations and common models used in the field of nanotribology and nanomechanics
- describe the most important experimental methods in nanotribology
- critically evaluate scientific papers on nanotribological issues with respect to their substantial quality

preliminary knowledge in mathematics and physics recommended

regular attendance: 22.5 hours
preparation for presentation: 22.5 hours
self-study: 75 hours

presentation (40%) and oral examination (30 min, 60%)
no tools or reference materials

Organizational issues
Die Vorlesung wird auf Deutsch (SoSe) und auf Englisch (WiSe) angeboten!
Kontakt: martin.dienwiebel@kit.edu

Literature
Edward L. Wolf
Nanophysics and Nanotechnology, Wiley-VCH, 2006

C. Mathew Mate

Tafelbilder, Folien, Kopien von Artikeln

Nanotribology and Mechanics
2182712, WS 21/22, 2 SWS, Language: English, Open in study portal
Content
In the summer semester the lecture is offered in German and in the winter semester in English!

Part 1: Fundamentals of nanotribology

- General tribology / nanotechnology
- Forces and dissipation on the nanometer scale
- Experimental methods (SFA, QCM, FFM)
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preliminary knowledge in mathematics and physics recommended

regular attendance: 22.5 hours
preparation for presentation: 22.5 hours
self-study: 75 hours

presentation (40%) and oral examination (30 min, 60%)
no tools or reference materials

Organizational issues
Anmeldung per Email bis zum 08.10.2021 an den Dozenten: martin.dienwiebel@kit.edu

Literature
Tafelbilder, Folien, Kopien von Artikeln
**10.313 Course: Neutron Physics of Fusion Reactors [T-MACH-105435]**

**Responsible:** Dr. Ulrich Fischer  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102643 - Major Field: Fusion Technology

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**Events**

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**Exams**

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<td>Lecture</td>
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**Competence Certificate**
oral exam of about 30 minutes

**Prerequisites**
none

**Annotation**
none

Below you will find excerpts from events related to this course:

**Neutron physics of fusion reactors**
2189473, WS 21/22, 2 SWS, Language: German/English, Open in study portal

**Lecture (V)**
On-Site

**Content**
Nuclear interaction processes and energy release  
Chain reaction and criticality  
Neutron transport, Boltzmann equation  
Diffusion approximation, Monte Carlo method  
Neutronic reactor design

The aim of this lecture is to provide the neutron physics principles required for analysis of nuclear fission and fusion reactors. First of all, the basic nuclear interaction processes are presented which are important for the physical behaviour of the reactors. Next the neutron transport phenomenon in matter is described by means of the Boltzmann transport equation. Suitable mathematical solution methods are presented such as the diffusion approximation for nuclear fission reactors and the Monte Carlo method for fusion reactors. The knowledge acquired will eventually be used to solve neutron physics problems related to the design and optimization of the reactors.

oral exam, duration: approximately 30 minutes, no tools or reference materials may be used during the exam  
regular attendance: 21 h  
self-study: 42 h

Admission to Campus North is required, please register to attend the lecture at: il-sekretariat@inr.kit.edu

**Literature**
K. H. Beckurts, K. Wirtz, Neutron Physics, Springer Verlag, Berlin, Germany (1964)


10.314 Course: NMR micro probe hardware conception and construction [T-MACH-108407]

**Responsible:** Prof. Dr. Jan Gerrit Korvink

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102616 - Major Field: Microsystem Technology

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<td>NMR micro probe hardware conception and construction</td>
<td>2 SWS</td>
<td>Practical course / 🧩 Korvink, Jouda</td>
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<td>NMR micro probe hardware conception and construction</td>
<td>Korvink</td>
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</table>

**Competence Certificate**
Successful participation.

**Prerequisites**
none

Below you will find excerpts from events related to this course:

**NMR micro probe hardware conception and construction**
2142551, SS 2021, 2 SWS, Language: English, Open in study portal

**Practical course (P)**
Blended (On-Site/Online)

**Content**
In order to prepare attendees, the following chapters will be offered, spread over the week as lecture units, and accompanying the practical work:
- Theory of magnetic resonance imaging
- The MRI probe and the principle of reciprocity
- RF resonators
- Coaxial cables and cable traps
- Tuning and matching the MRI probe
- Effects of material susceptibility
- The mechanical support of the MRI probe
- Introduction to ParaVision, the MRI imaging software.

**Organizational issues**
Blockveranstaltung am CN, Bau 301, Raum 322, Anmeldung an Mazin.Jouda@kit.edu
10.315 Course: Nonlinear Continuum Mechanics [T-MACH-111026]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke

**Organisation:**
- Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102611 - Major Field: Materials Science and Engineering
- M-MACH-102646 - Major Field: Applied Mechanics
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

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**Events**

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**Competence Certificate**

oral examination (approx. 25 min)

**Prerequisites**

Passing the "Tutorial Nonlinear Continuum Mechanics" (T-MACH-111027) is a prerequisite for taking part in the exam.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-111027 - Tutorial Nonlinear Continuum Mechanics must have been passed.

**Below you will find excerpts from events related to this course:**

**Nonlinear Continuum Mechanics**

2162344, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V) Blended (On-Site/Online)**

**Content**

- tensor calculus, kinematics, balance equations
- principles of material theory
- finite elasticity
- infinitesimal elasto(visco)plasticity
- exact solutions of infinitesimal Plasticity
- finite elasto(visco)plasticity
- infinitesimal and finite crystal(visco)plasticity
- hardening and failure
- strain localization

**Organizational issues**

Siehe Aushang am Institut bzw. Informationen auf der website

**Literature**

- Vorlesungsskript
10.316 Course: Nonlinear optimization methods [T-MACH-110380]

**Responsible:** Jun.-Prof. Dr. Matti Schneider

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102646 - Major Field: Applied Mechanics
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

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<td>Each winter term</td>
<td>1 terms</td>
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</table>

**Competence Certificate**

Oral examination

**Below you will find excerpts from events related to this course:**

**Nonlinear optimization methods (Lecture)**

2161130, WS 21/22, 2 SWS, Language: German, Open in study portal

**Content**

- The method of Newton-Kantorovich
- Gradient methods and their accelerations
- Constrained optimization
- Modern operator splitting schemes

**Literature**

10 COURSES

Course: Novel Actuators and Sensors [T-MACH-102152]

**Responsible:** Prof. Dr. Manfred Kohl
Dr. Martin Sommer

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102599 - Major Field: Powertrain Systems
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102616 - Major Field: Microsystem Technology
- M-MACH-102633 - Major Field: Robotics
- M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools
- M-MACH-102647 - Major Field: Microactuators and Microsensors
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
- M-MACH-102742 - Fundamentals and Methods of Production Technology

**Type:** Written examination

**Credits:** 4

**Grading scale:** Grade to a third

**Recurrence:** Each winter term

**Version:** 3

### Events

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**Competence Certificate**

written exam, 60 minutes

**Prerequisites**

none

**Below you will find excerpts from events related to this course:**

### Literature

- Vorlesungsskript " Neue Aktoren" und Folienskript "Sensoren"
- Donald J. Leo, Engineering Analysis of Smart Material Systems, John Wiley & Sons, Inc., 2007
10.318 Course: Nuclear Fusion Technology [T-MACH-110331]

**Responsible:** Dr. Aurelian Florin Badea  
**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-102608 - Major Field: Nuclear Energy

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**Exams**

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**  
oral exam, approx. 20 min.

**Prerequisites**

none

**Below you will find excerpts from events related to this course:**

**V Nuclear Fusion Technology**

2189920, WS 21/22, 2 SWS, Language: English, [Open in study portal]

**Lecture (V) Online**

**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
10.319 Course: Nuclear Medicine and Measuring Techniques I [T-ETIT-100664]

**Responsible:** Prof. Dr. Olaf Dössel  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-102615 - Major Field: Medical Technology

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<td>Maul</td>
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</tbody>
</table>

**Competence Certificate**

Success control is carried out as part of an overall oral examination (20 minutes).

**Prerequisites**

none
10.320 Course: Nuclear Power and Reactor Technology [T-MACH-110332]

**Responsible:** Dr. Aurelian Florin Badea  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102608 - Major Field: Nuclear Energy

<table>
<thead>
<tr>
<th>Events</th>
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**Exams**

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</table>

**Competence Certificate**

oral exam, approx. 20 min.

**Prerequisites**

None

**Below you will find excerpts from events related to this course:**

Nuclear Power and Reactor Technology

2189921, WS 21/22, 3 SWS, Language: English, Open in study portal

Lecture (V)

Online

**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
10.321 Course: Nuclear Power Plant Technology [T-MACH-105402]

**Responsible:** Dr. Aurelian Florin Badea  
Prof. Dr.-Ing. Xu Cheng  
Hon.-Prof. Dr. Thomas Schulenberg

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102608 - Major Field: Nuclear Energy  
M-MACH-102610 - Major Field: Power Plant Technology

<table>
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<td>Grade to a third</td>
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**Events**

| ST 2021 | 2170460 | Nuclear Power Plant Technology | 2 SWS | Lecture / 🖥 | Cheng, Schulenberg |

**Exams**

| ST 2021 | 76-T-MACH-105402 | Nuclear Power Plant Technology | Cheng, Schulenberg |

**Competence Certificate**
oral exam, Duration: approximately 30 minutes  
no tools or reference materials may be used during the exam

**Prerequisites**
none

**Below you will find excerpts from events related to this course:**

| Nuclear Power Plant Technology | 2170460, SS 2021, 2 SWS, Language: English | Lecture (V) Online |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
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
**10.322 Course: Numerical Fluid Mechanics [T-BGU-106758]**

**Responsible:** Prof. Dr.-Ing. Markus Uhlmann  
**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences  
**Part of:** M-MACH-102634 - Major Field: Fluid Mechanic

<table>
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**Events**

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**Exams**

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</table>

**Legend:** Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**
written exam, 90 min.

**Prerequisites**
none

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-105338 - Numerical Fluid Mechanics must not have been started.

**Recommendation**
none

**Annotation**
none
10.323 Course: Numerical Fluid Mechanics [T-MACH-105338]

**Responsible:** Dr.-Ing. Franco Magagnato

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102604 - Major Field: Computational Mechanics
- M-MACH-102610 - Major Field: Power Plant Technology
- M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology
- M-MACH-102627 - Major Field: Energy Converting Engines
- M-MACH-102634 - Major Field: Fluid Mechanics

**Type**
- Oral examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each winter term

**Version**
- 2

**Events**

<table>
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<td>Grade to a third</td>
<td>Each winter term</td>
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</table>

**Competence Certificate**

oral exam - 30 minutes

**Prerequisites**

none

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-BGU-106758 - Numerical Fluid Mechanics must not have been started.

**Below you will find excerpts from events related to this course:**

**Numerical Fluid Mechanics**

2153441, WS 21/22, 2 SWS, Language: German, Open in study portal

**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
5. solution algorithms for linear and nonlinear systems of equations
6. solution strategies for the incompressible Navier-Stokes equations
7. introduction to the solution of the compressible Navier-Stokes equations
8. examples of numerical simulation in practice

**Literature**


10.324 Course: Numerical Fluid Mechanics with PYTHON [T-MACH-110838]

**Responsible:** Prof. Dr.-Ing. Bettina Frohnapfel

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102634 - Major Field: Fluid Mechanic

<table>
<thead>
<tr>
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**Events**

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<th>Grading</th>
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<td>ST 2021</td>
<td>2154405</td>
<td>Numerical Fluid Mechanics with Python</td>
<td>2 SWS</td>
<td>Gatti, Frohnapfel</td>
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**Exams**

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<th>Grading</th>
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<td>Numerical Fluid Mechanics with Python</td>
<td>2 SWS</td>
<td>Frohnapfel, Gatti</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

ungraded homework

**Prerequisites**

none

Below you will find excerpts from events related to this course:

**Numerical Fluid Mechanics with Python**

2154405, SS 2021, 2 SWS, Language: German, Open in study portal

**Practical course (P)**

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 Teilnehmerzahl ist begrenzt, bitte im Sekretariat des ISTM bis zum 23.07.21 per E-Mail anmelden.

**Literature**


10.325 Course: Numerical Mathematics for Students of Computer Science [T-MATH-102242]

**Responsible:** Prof. Dr. Andreas Rieder  
Dr. Daniel Weiß  
Prof. Dr. Christian Wieners  

**Organisation:** KIT Department of Mathematics  

**Part of:**  
- M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering  
- M-MACH-102594 - Mathematical Methods  
- M-MACH-102646 - Major Field: Applied Mechanics  
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering  
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology  
- M-MACH-102742 - Fundamentals and Methods of Production Technology  
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering  

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<td>Each term</td>
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**Events**

| ST 2021  | 0187400 | Numerische Mathematik für die Fachrichtungen Informatik und Ingenieurwesen | 2 SWS | Lecture / 🖥 | Jahnke |
| ST 2021  | 0187500 | Übungen zu 0187400 | 1 SWS | Practice / 🖥 | Jahnke |

**Exams**

| ST 2021 | 770100085 | Numerical Mathematics for Students of Computer Science | Jahnke |

**Competence Certificate**
written exam, 120 min.

**Prerequisites**
none
**10.326 Course: Numerical Mechanics for Industrial Applications [T-MACH-108720]**

**Responsible:** Prof. Dr. Eckart Schnack  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics  
- M-MACH-102607 - Major Field: Vehicle Technology

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**Events**

| Events | ST 2021 2162298 | Numerical mechanics for industrial applications | 3 SWS | Lecture / 🗣 | Schnack |

| Exams | ST 2021 76-T-MACH-108720 | Numerical Mechanics for Industrial Applications |

Legend: 🖥 Online, 🎧 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**  
Oral exam, 20 minutes

**Prerequisites**

None

**Below you will find excerpts from events related to this course:**

**Numerical mechanics for industrial applications**

2162298, SS 2021, 3 SWS, Language: German, [Open in study portal](#)

**Lecture (V) On-Site**

**Content**


**Literature**

10.327 Course: Numerical Simulation of Multi-Phase Flows [T-MACH-105420]

Responsible: Dr. Martin Wörner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102634 - Major Field: Fluid Mechanics

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Events

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Exams

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Legend: 🥑 Online, 🧩 Blended (On-Site/Online), 🗓 On-Site, ☠ Cancelled

Competence Certificate
oral exam 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

Numerical Modeling of Multiphase Flows

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<th>Title</th>
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<th>Type</th>
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<td>2</td>
<td>Lecture / 🥑</td>
<td>Wörner</td>
</tr>
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</table>

Lecture (V)  
Online

Content

1. Introduction in the subject of multi-phase flows (terms and definitions, examples)
2. Physical fundamentals (dimensionless numbers, phenomenology of single bubbles, conditions at fluid interfaces, forces on a suspended particle)
3. Mathematical fundamentals (governing equations, averaging, closure problem)
4. Numerical fundamentals (discretization in space and time, truncation error and numerical diffusion)
5. Models for interpenetrating continua (homogeneous model, algebraic slip model, standard two-fluid model and its extensions)
6. Euler-Lagrange model (particle equation of motion, particle response time, one-/two-/four-way coupling)
7. Interface resolving methods (volume-of-fluid, level-set and front-capturing method)

Organizational issues
Mündliche Prüfung, Dauer: 30 Minuten, Hilfsmittel: keine
Oral examination (in German or English language), Duration: 30 minutes, Auxiliary means: none

Literature
Die Powerpoint-Folien werden nach jeder Vorlesung im ILIAS-System zum Herunterladen bereitgestellt.
Eine Liste mit Buchempfehlungen wird in der ersten Vorlesungsstunde ausgegeben.
# 10.328 Course: Numerical Simulation of Reacting Two Phase Flows [T-MACH-105339]

**Responsible:** Dr.-Ing. Rainer Koch  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102604 - Major Field: Computational Mechanics  
- M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering  
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology  
- M-MACH-102634 - Major Field: Fluid Mechanic  
- M-MACH-102636 - Major Field: Thermal Turbomachines

<table>
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<td>Koch</td>
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**Exams**

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<td>Koch</td>
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Legend: 🖥 Online, ☭ Blended (On-Site/Online), 🗣 On-Site, 🗿 Cancelled

**Competence Certificate**

**Oral exam**  
Duration: approximately 30 minutes  

**Prerequisites**

none

**Below you will find excerpts from events related to this course:**

**Numerical simulation of reacting two phase flows**

<table>
<thead>
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<th>Code</th>
<th>Description</th>
<th>Instructor</th>
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<tbody>
<tr>
<td>V</td>
<td>2169458</td>
<td>Numerical simulation of reacting two phase flows</td>
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</table>

Lecture (V)  
On-Site

---

Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021  
Module Handbook, valid from Winter Term 2021/2022
Content
The course is devoted to diploma/master students and doctoral candidates of mechanical and chemical engineering. It gives an overview of the numerical methods used for CFD of single and two phase flows. The course introduces methods for reacting single and two phase flows, as they are typically found in gas turbines and piston engines operated by liquid fuel.


2. Two phase flows: Basics of atomisation, Characterisation of sprays, Numerical prediction of droplet movement, Numerical methods for predicting of liquid disintegration (VoF, SPH), Numerical methods for secondary atomisation; Droplet evaporation

3. Reacting flows: Combustion models; Single droplet combustion, Spray combustion.

The students have the ability to:

- describe and apply the governing equations of fluid mechanics
- select and judge appropriate methods for predicting turbulent flows
- explain the procedures of numerical solver algorithms
- judge the numerical methods, on which common CFD software is based
- judge and apply different approaches to characterize sprays
- apply methods for predicting the break up of liquids
- analyse and evaluate methods and models for the calculation of multiphase flows
- describe reactive flows and the corresponding models

regular attendance: 21 h
self-study: 42 h

Oral exam
Duration: approximately 30 minutes

no tools or reference materials are allowed

Organizational issues
Vorlesung findet in Präsenz statt, sofern die COVID-Inzidenzwerte es zulassen.

Literature
Vorlesungsskript
Lecture notes
**10.329 Course: Numerical Simulation of Turbulent Flows [T-MACH-105397]**

**Responsible:** Dr. Günther Grötzbach  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102604 - Major Field: Computational Mechanics  
- M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering  
- M-MACH-102634 - Major Field: Fluid Mechanics

**Events**

<table>
<thead>
<tr>
<th>Events</th>
<th>2153449</th>
<th>Numerical Simulation of Turbulent Flows</th>
<th>3 SWS</th>
<th>Lecture / 🗣</th>
<th>Grötzbach</th>
</tr>
</thead>
</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**  
oral

**Duration:** 30 minutes  
**no auxiliary means**

**Prerequisites**  
one

**Recommendation**  
Basics in fluid mechanics

Below you will find excerpts from events related to this course:

**Numerical Simulation of Turbulent Flows**  
2153449, WS 21/22, 3 SWS, Language: German, [Open in study portal]

**Content**  
The students are qualified to describe the fundamentals of direct numerical simulation (DNS) and large eddy simulation (LES) of turbulent flows. They understand the principle differences between these simulation methods and the respective properties of the conventional turbulence modelling approaches basing on Reynolds Averaged Navier-Stokes equations (RANS). They can describe subgrid scale models, peculiarities of wall and inlet/outlet modelling, suitable numerical solution schemes and evaluation methods. They have obtained the knowledge and understanding required to identify the best modelling approach (among the available methods) for the problem at hand, thus being able to solve given thermal and fluid dynamical problems appropriately.

The lecture series will introduce in following subjects of the turbulence simulation method:

- Appearance of turbulence and deduction of requirements and limits of the simulation method.  
- Conservation equations for flows with heat transfer, filtering them in time or space.  
- Some subgrid scale models for small scale turbulence and their physical justification.  
- Peculiarities in applying boundary and initial conditions.  
- Suitable numerical schemes for integration in space and time.  
- Statistical and graphical methods to analyse the simulation results.  
- Application examples for turbulence simulations in research and engineering

**Organizational issues**  
Dauer der Vorlesung 3 h von 14:00 - 15:30 h und von 15:45 - 16:30 h./Duration of the lecture 3 h from 14:00 - 15:30 h and from 15:45 - 16:30 h.
Literature
G. Grötzbach, Script in English
10.330 Course: Numerical Solution of Nonlinear Equations [T-MACH-111023]

Responsible: Jun.-Prof. Dr. Matti Schneider

Organisation:
Part of: M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

<table>
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<tr>
<th>Type</th>
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<th>Grading scale</th>
<th>Recurrence</th>
<th>Expansion</th>
<th>Version</th>
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<tr>
<td>Oral exam</td>
<td>6</td>
<td>Grade to a third</td>
<td>Each term</td>
<td>1 terms</td>
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</tr>
</tbody>
</table>

Events

| ST 2021 | 2162278 | Numerical Solution of Nonlinear Equations | 2 SWS | Lecture / Online | Schneider |

Exams

| ST 2021 | 76-T-MACH-111023 | Numerical Solution of Nonlinear Equations | Schneider |

Legend: 🌈 Online, 🕰 Blended (On-Site/Online), 🗯 On-Site, ✗ Cancelled

Competence Certificate
oral examination, approx 30 minutes

Prerequisites
none

Recommendation
Lecture on Advanced Mathematics are assumed to be known
This lecture is intended for MSc students

Below you will find excerpts from events related to this course:

Numerical Solution of Nonlinear Equations
2162278, SS 2021, 2 SWS, Language: German/English, Open in study portal

Content
Fixed point methods and monotone operators; Applications of monotone operators; Newton methods
10.331 Course: Occupational Safety and Environmental Protection [T-MACH-105386]

**Responsible:** Rainer von Kiparski  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102600 - Major Field: Man - Technology - Organisation  
M-MACH-102610 - Major Field: Power Plant Technology

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**Events**

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<tr>
<td>ST 2021</td>
<td>2110037</td>
<td>Occupational Safety and Environmental Protection</td>
<td>2 SWS</td>
<td>/ x</td>
<td>von Kiparski</td>
</tr>
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</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

oral exam (approx. 30 min)  
The exam is offered in German only!

**Prerequisites**

none

Below you will find excerpts from events related to this course:

**Occupational Safety and Environmental Protection**

2110037, SS 2021, 2 SWS, Language: German, [Open in study portal] Cancelled

**Content**

The participants have to solve a specific case study within the field of occupational safety and environmental protection. Therefore, they work in a team. The course work covers the information research as well as the presentation of the results.

Content:

- Occupational Safety and Safety Engineering  
- Environmental Protection within a Production Enterprise  
- Health Management

**Structure:**

- Terminology  
- Basics of Occupational Safety and Environmental Protection  
- Case Study  
- Moderated Processing of a Case Study within a Small Group

**Organizational issues**

Die Vorlesung "Industrieller Arbeits- und Umweltschutz" wird aufgrund der momentanen Situation für dieses Sommersemester nochmal abgesagt.

**Literature**

Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.

Responsible:  Prof. Dr.-Ing. Bettina Frohnapfel
             Prof. Dr.-Ing. Friedrich Seiler

Organisation:  KIT Department of Mechanical Engineering

Part of:  M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

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</table>

Competence Certificate
oral exam 30 minutes

Prerequisites
none
### 10.333 Course: Optical Measuring Systems [T-MACH-111249]

**Responsible:** PD Dr.-Ing. Ingo Sieber  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102598 - Major Field: Advanced Mechatronics  
- M-MACH-102601 - Major Field: Automation Technology  
- M-MACH-102614 - Major Field: Mechatronics  
- M-MACH-102615 - Major Field: Medical Technology  
- M-MACH-102633 - Major Field: Robotics

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**Events**

| ST 2021 | 2106010 | Optical Measuring Systems | 2 SWS | Lecture / Online | Sieber |

Legend: 🥱 Online, 🌈 Blended (On-Site/Online), ⚒ On-Site, ☢ Cancelled

**Competence Certificate**  
oral exam (Duration: appr. 30min)

**Prerequisites**  
none

**Below you will find excerpts from events related to this course:**

**Optical Measuring Systems**  
2106010, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V) Online**

**Content**

The lecture gives an introduction to optical measuring systems and optical metrology. Optical metrology offers the advantages of non-contact and fast measurement and is therefore also suitable for direct measurements during the process.

The measuring systems are described on the basis of the underlying physical principles and their practical application is demonstrated using specific examples.

**Content:**

- Introduction  
- Optical measurement principles  
- System / Optics and Light  
- Optical components  
- Optical systems for  
  - Distance measurement  
  - Surface measurement  
  - Gas sensing

**Learning objectives:**

The students…

- know the basics of optical metrology.  
- know different optical measuring principles.  
- know the function of optical components.  
- are able to find and use the appropriate measuring system for different measuring tasks.

**Organizational issues**

Die LV wird ab SS 2022 angeboten.
Literature

Course: Organ Support Systems [T-MACH-105228]

Responsible: apl. Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102615 - Major Field: Medical Technology

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Events

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Exams

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Legend: 🖥️ Online, 🧩 Blended (On-Site/Online), ⚒ On-Site, ✗ Cancelled

Competence Certificate
Written examination (Duration: 45min)

Prerequisites
none

Below you will find excerpts from events related to this course:

Organ support systems
2106008, SS 2021, 2 SWS, Language: German, Open in study portal

V Lecture (V)
Online

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 transplantsations can be elaborated.

Literature

- E. Wintermantel, Suk-Woo Ha: Medizintechnik. Springer Verlag.
10.335 Course: Phase Transformations in Materials [T-MACH-111391]

Responsible: Prof. Dr.-Ing. Martin Heilmaier  
Dr.-Ing. Alexander Kauffmann

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102611 - Major Field: Materials Science and Engineering

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<tr>
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<th>Recurrence</th>
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<td>Each winter term</td>
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Events

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<td>Phase Transformations in Materials</td>
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<td>Lecture / 🧩</td>
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Exams

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<th>Course Code</th>
<th>Course Title</th>
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</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

Competence Certificate
oral exam (about 25 min.)

Prerequisites
none

Recommendation
Materials Science and Engineering I/II and some additional fundamentals on thermodynamics and diffusion or Materials Physics and Metals

Below you will find excerpts from events related to this course:

Phases Transformations in Materials

2173421, WS 21/22, 3 SWS, Language: English, Open in study portal  
Lecture (V)  
Blended (On-Site/Online)
Content

Learning objectives:

Students are familiar with a generalized scheme of phase transformations important in materials science and engineering. This includes qualitative and quantitative description of thermodynamics and kinetics of phase transformations. The students are able to apply their fundamental knowledge in order to describe important phase transformations and to deduce properties of materials undergoing these transformations.

Content:

- General considerations on phase transformations
- Thermodynamic and kinetic fundamentals (material provided for self-study)
- Single-component systems
- Solidification and allotropic transformations (discontinuous)
- Continuous phase transitions, e.g. ferroic transformations
- Multi-component systems
- Reconstructive transformation (changes are achieved by long-range diffusion)
  - Spinodal decomposition (change in composition, not in crystal structure)
  - Precipitation (change in composition and crystal structure from one parent phase into a two-phase microstructure)
  - Eutectic reaction (invariant reaction with change in composition and crystal structure resulting in a two-phase microstructure)
  - Peritectic reaction (invariant reaction with change in composition and crystal structure from two parent phases to a single phase)
- Displacive transformation (no long-range diffusion and changes in crystal structure are achieved by deformation)
  - Shear transformation
  - Dilatation transformation
  - Transformation by shuffling
- Intermediate transitions (no long-range diffusion or only of some of the species)
  - Order transition (symmetry break in crystal structure by resembling site occupation, no change in total composition)
  - Massive transformation (change in crystal structure without change in total composition)
  - Bainite formation and Widmannstätten ferrite

Work Load

lectures: 36 h
private studies: 64 h

Organizational issues

Details about the lecture are distributed via: https://www.iam.kit.edu/wk/english/studies.php

Literature

Powerpoint slides will be distributed via the ILIAS system.
Detailed information are available for different sub topics of the lecture from:

https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC27759961X

https://doi.org/10.1016/0079-6425(85)90004-0 [currently not available from KIT network but maybe accessed by LEA]

https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC518051110 [free online access from within KIT network]

https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC030295610

http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656

https://www.ifw-dresden.de/institutes/ifw/events/lectures/lecture-notes/physikalische-werkstoffeigenschaften/ [public domain]
10.336 Course: Photovoltaic System Design [T-ETIT-100724]

Responsible: Dipl.-Ing. Robin Grab
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102648 - Major Field: Energy Technology for Buildings

<table>
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<td>Each summer term</td>
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Events

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<td>Photovoltaische Systemtechnik</td>
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Exams

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Legend: 🖥 Online, ☒ Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Prerequisites
none
### 10.337 Course: Photovoltaics [T-ETIT-101939]

**Responsible:** Prof. Dr.-Ing. Michael Powalla  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:**  
- M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering  
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology

<table>
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**Events**

| ST 2021 | 2313737 | Photovoltaics | 4 SWS | Lecture / | Powalla, Lemmer |
| ST 2021 | 2313738 | Tutorial 2313737 Photovoltaik | 1 SWS | Practice / | Powalla, Lemmer |

**Exams**

| ST 2021 | 7313737 | Photovoltaics | Powalla, Lemmer |

Legend:  
- Online,  
- Blended (On-Site/Online),  
- On-Site,  
- Cancelled

**Prerequisites**

"M-ETIT-100524 - Solar Energy" must not have started.

Responsible: apl. Prof. Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102623 - Major Field: Fundamentals of Energy Technology

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<td>Each winter term</td>
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Events

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<td>WT 21/22</td>
<td>1 SWS</td>
<td>Physical and chemical principles of nuclear energy in view of reactor accidents and back-end of nuclear fuel cycle</td>
<td>Dagan, Metz</td>
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Exams

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<th>Title</th>
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<tr>
<td>WT 21/22</td>
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<td>Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle</td>
<td>Dagan</td>
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</table>

Competence Certificate
oral exam, approx. 30 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

<table>
<thead>
<tr>
<th>Events</th>
<th>Type</th>
<th>Title</th>
<th>Credits</th>
<th>Grade to a third</th>
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<tr>
<td>V</td>
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<td>Physical and chemical principles of nuclear energy in view of reactor accidents and back-end of nuclear fuel cycle</td>
<td>Dagan</td>
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</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
Content

- Relevant physical terms of nuclear physics
- Decay heat removal- Borst-Wheeler equation
- The accidents in TMI- Three Mile Island, and Fukushima.
- Fission, chain reaction and reactor control systems
- Basics of nuclear cross sections
- Principles of reactor dynamics
- Reactor poisoning
- The Idaho and Chernobyl accidents
- Principles of the nuclear fuel cycle
- Reprocessing of irradiated fuel elements and vitrification of fission product solutions
- Interim storage of nuclear residues in surface facilities
- Multi barrier concepts for final disposal in deep geological formations
- The situation in the repositories Asse II, Konrad and Morsleben

The students

- understand the physical explanations of the known nuclear accidents
- can perform simplified calculations to demonstrate the accidents outcome.
- Define safety relevant properties of low/ intermediate / high level waste products
- Are able to evaluate principles and implications of reprocessing, storage and disposal options for nuclear waste.

Regular attendance: 14 h
self study 46 h
oral exam about 20 min.

Organizational issues
Die Veranstaltung wird nur online gehalten, falls durch Corona Einschränkungen vorgegeben werden.

Literature
AEA öffentliche Dokumentation zu den nuklearen Ereignissen
K. Wirtz: Grundlagen der Reaktortechnik Teil I, II, Technische Hochschule Karlsruhe 1966
J. Duderstadt and L. Hamilton: Nuclear reactor Analysis, J. Wiley $ Sons , Inc. 1975 (in English)
R.C. Ewing: The nuclear fuel cycle: a role for mineralogy and geochemistry. Elements vol. 2, p.331-339, 2006 (in English)
J. Bruno, R.C. Ewing: Spent nuclear fuel. Elements vol. 2, p.343-349, 2006 (in English)

Responsible: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

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Events

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<td>Physical basics of laser technology</td>
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</table>

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate

colloquium (30 min)

no tools or reference materials

Prerequisites

It is not possible, to combine this brick with brick Laser Application in Automotive Engineering [T-MACH-105164] and brick Physical Basics of Laser Technology [T-MACH-102102]

Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-105164 - Laser in Automotive Engineering must not have been started.
2. The course T-MACH-102102 - Physical Basics of Laser Technology must not have been started.

Recommendation

basic knowledge of physics, chemistry and material science

Below you will find excerpts from events related to this course:

V Physical basics of laser technology
2181612, WS 21/22, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
Online
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
- safety aspects

The lecture is complemented by a tutorial.

The student

- can explain the principles of light generation, the conditions for light amplification as well as the basic structure and function of different laser sources.
- can describe the influence of laser, material and process parameters for the most important methods of laser-based materials processing and choose laser sources suitable for specific applications.
- can illustrate the possible applications of laser sources in measurement and medicine technology
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.
regular attendance: 33,5 hours
self-study: 116,5 hours

The assessment consists of an oral exam (ca. 30 min) taking place at the agreed date (according to Section 4(2), 2 of the examination regulation). The re-examination is offered upon agreement.

It is allowed to select only one of the lectures "Laser in automotive engineering" (2182642) or "Physical basics of laser technology" (2181612) during the Bachelor and Master studies.

Organizational issues
Termine für die Übung werden in der Vorlesung bekannt gegeben!

Literature
T. Graf: Laser - Grundlagen der Laserstrahlerzeugung 2015, Springer Vieweg
R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer

**Responsible:** Dr.-Ing. Johannes Schneider  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering  
- M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering  
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology  
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction  
- M-MACH-102742 - Fundamentals and Methods of Production Technology  
- M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

**Type**  
- Oral examination  
**Credits**  
- 5  
**Grading scale**  
- Grade to a third  
**Recurrence**  
- Each winter term  
**Version**  
- 3

**Events**

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<td>Each winter term</td>
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**Exams**

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</table>

**Legend:**  
- Online  
- Blended (On-Site/Online)  
- On-Site  
- Cancelled

**Competence Certificate**

oral examination (30 min)

**no tools or reference materials**

**Prerequisites**

It is not possible to combine this brick with brick Laser Application in Automotive Engineering [T-MACH-105164] and brick Physical Basics of Laser Technology [T-MACH-109084]

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-105164 - Laser in Automotive Engineering must not have been started.
2. The course T-MACH-109084 - Physical Basics of Laser Technology must not have been started.

**Recommendation**

Basic knowledge of physics, chemistry and material science

**Below you will find excerpts from events related to this course:**
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
- safety aspects

The lecture is complemented by a tutorial.

The student

- can explain the principles of light generation, the conditions for light amplification as well as the basic structure and function of different laser sources.
- can describe the influence of laser, material and process parameters for the most important methods of laser-based materials processing and choose laser sources suitable for specific applications.
- can illustrate the possible applications of laser sources in measurement and medicine technology
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

regular attendance: 33.5 hours
self-study: 116.5 hours

The assessment consists of an oral exam (ca. 30 min) taking place at the agreed date (according to Section 4(2), 2 of the examination regulation). The re-examination is offered upon agreement.

It is allowed to select only one of the lectures "Laser in automotive engineering" (2182642) or "Physical basics of laser technology" (2181612) during the Bachelor and Master studies.

Organizational issues
Termine für die Übung werden in der Vorlesung bekannt gegeben!

Literature
T. Graf: Laser - Grundlagen der Laserstrahlerzeugung 2015, Springer Vieweg
R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer
Course: Physical Measurement Technology [T-MACH-111022]

**Responsible:** Dr. Dominique Buchenau
Prof. Dr. Robert Stieglitz

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102627 - Major Field: Energy Converting Engines
- M-MACH-102635 - Major Field: Engineering Thermodynamics
- M-MACH-102643 - Major Field: Fusion Technology
- M-MACH-102648 - Major Field: Energy Technology for Buildings

**Type**
- Oral examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each winter term

**Version**
- 1

**Events**

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<td>Each winter term</td>
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</tbody>
</table>

**Competence Certificate**

- Oral exam of about 25 minutes

**Prerequisites**

- none

**Annotation**

- none

Below you will find excerpts from events related to this course:

**Physical Measurement Technology**

- 2189490, WS 21/22, 2 SWS, Language: German/English, [Open in study portal](#)

Legend: 📀 Online, 🛩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
Content

Qualification targets:

Acquisition of knowledge:

- fundamentals of electrical measurement technology
- conversion principles of physical quantities into electrical signals
- conversion and processing of non-electrical quantities
- characteristics and transmission properties of sensors
- basics of analog and digital data acquisition & processing
- fundamentals of optical measurement methods

Skills:

- handling with electrical measuring instruments
- application and handling of simple measurement circuits
- measurement data acquisition and processing, representation of functional dependencies
- analysis of measuring tasks, selection of measuring methods and instruments
- assessment of measurement errors, reduction of systematic errors

Expertise:

- problem analysis and development of suitable solutions
- planning and design of measuring systems
- planning and installation of automated measurement equipment
- assessment of the quality of measurement procedures and results

Structure of Content:

- general introduction
- evaluation of measurement data
- important concepts of measurement techniques
- sensor concepts according to physical effects
- special concepts of physical measurement technology
- D/A and A/D conversion of electrical signals
- digital and analog modulation techniques

Usability:

Suitable for Bachelor program with the following specialisations:

- mechanical engineering
- physical engineering science
- production engineering / Transportation
- information technology in mechanical engineering

The acquired know-how is relevant for all engineering disciplines, especially in the following areas: precision engineering, mechatronics, medical technology, measurement and automation technology etc.

Work input:

Total extent approx. 120 h / thereof 30 h in classroom lecture and exercise

Examination:

The lecture will be concluded by an oral exam of about 25 minutes.

Literature

- Hecht, E., Optik, Oldenbourg-Verlag, 2005, ISBN 3-486-27359-0
10.342 Course: Physics for Engineers [T-MACH-100530]

**Responsible:** Prof. Dr. Martin Dienwiebel  
Prof. Dr. Peter Gumbsch  
apl. Prof. Dr. Alexander Nesterov-Müller  
Dr. Daniel Weygand

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering  
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering  
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology  
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering  
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

**Type** 
Written examination

**Credits** 
5

**Grading scale** 
Grade to a third

**Recurrence** 
Each summer term

**Version** 
1

**Events**

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<td>4 SWS</td>
<td>Lecture / Practice (🖥)</td>
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**Exams**

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ☢ Cancelled

**Competence Certificate**
written exam 90 min

**Prerequisites**
none

Below you will find excerpts from events related to this course:

**Physics for Engineers**

<table>
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<td>2142890</td>
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<td>Lecture / Practice (VÜ) Online</td>
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</table>

Open in study portal
Content
1) Foundations of solid state physics
   - Wave particle dualism
   - Tunnelling
   - Schrödinger equation
   - H-atom

2) Electrical conductivity of solids
   - solid state: periodic potentials
   - Pauli Principle
   - band structure
   - metals, semiconductors and isolators
   - p-n junction / diode

3) Optics
   - quantum mechanical principles of the laser
   - linear optics
   - non-linear optics

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students and for testing progress in learning of the topics.

The student
   - has the basic understanding of the physical foundations to explain the relationship between the quantum mechanical principles and the optical as well as electrical properties of materials
   - can describe the fundamental experiments, which allow the illustration of these principles

regular attendance: 22.5 hours (lecture) and 22.5 hours (excerises)
self-study: 105 hours

The assessment consists of a written exam (90 minutes) (following §4(2), 1 of the examination regulation).

Organizational issues
Kursbeitritt erfolgt bis zum 15.4.2021 (erste Vorlesung) ohne Passwort.
Kontakt: daniel.weygand@kit.edu

Literature
   - Tipler und Mosca: Physik für Wissenschaftler und Ingenieure, Elsevier, 2004
   - Harris, Moderne Physik, Pearson Verlag, 2013
### 10.343 Course: Physiology and Anatomy for Engineers I [T-ETIT-101932]

**Responsible:** Prof. Dr. Werner Nahm

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

<table>
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#### Events

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#### Exams

| ST 2021 | 7305281 | Physiology and Anatomy for Engineers I | Breustedt |

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 📋 On-Site, ✗ Cancelled

**Competence Certificate**

Success control is carried out in the form of a written test of 60 minutes.

**Prerequisites**

none
## 10.344 Course: Physiology and Anatomy for Engineers II [T-ETIT-101933]

**Responsible:** Prof. Dr. Werner Nahm  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

<table>
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### Events

| ST 2021 | 2305282 | Physiology and Anatomy for Engineers II | 2 SWS | Lecture / 🖥 | Breustedt |

### Exams

| ST 2021 | 7305282 | Physiology and Anatomy for Engineers II | Breustedt |

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Success control is carried out in the form of a written test of 60 minutes.

**Prerequisites**

none

**Recommendation**

The contents of the M-ETIT-100390 module are required.
10.345 Course: Physiology/Sports Medicine II [T-GEISTSOZ-103290]

**Responsible:** Prof. Dr. Achim Bub

**Organisation:** KIT Department of Humanities and Social Sciences

**Part of:** M-MACH-102615 - Major Field: Medical Technology

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled
Course: Planning of Assembly Systems [T-MACH-105387]

Responsible: Eberhardt Haller
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102600 - Major Field: Man - Technology - Organisation
- M-MACH-102618 - Major Field: Production Technology

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Events

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<td>Planning of Assembly Systems (in German)</td>
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<td>Haller</td>
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<tr>
<td>WT 21/22</td>
<td>2109034</td>
<td>Planning of Assembly Systems (in German)</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
oral exam (approx. 30 min)
The exam is offered in German only!

Prerequisites
Timely pre-registration in ILIAS, since participation is limited.

Below you will find excerpts from events related to this course:

Planning of Assembly Systems (in German)
2109034, SS 2021, 2 SWS, Language: German, Open in study portal

Content
Content of teaching:
1. Planning guidelines
2. Vulnerability analysis
3. Planning of work systems (technical and organisational structuring principles, capacity planning, precedence diagram, payment system)
4. Evaluation
5. Presentation

Requirements:
- Compact course (one week full-time)
- Limited number of participants; seats are assigned according the date of registration
- Registration via ILIAS is required
- Compulsory attendance during the whole lecture

Recommendations:
- Knowledge of Human Factors Engineering or Production Management/Industrial Engineering helpful

The students
- know planning guidelines
- know vulnerability analysis
- are able to plan work systems (e.g. technical or organisational structuring principles, capacity planning, precedence diagram, payment system)
- are able to evaluate a planning solution
- are able to present results
Organizational issues
Da das ganze Sommersemester 2021 komplett digital stattfinden soll, muss diese Präsenzveranstaltung leider abgesagt werden.

Literature
Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.

Planning of Assembly Systems (in German)
2109034, WS 21/22, 2 SWS, Language: German, Open in study portal

Content
Content of teaching:

1. Planning guidelines
2. Vulnerability analysis
3. Planning of work systems (technical and organisational structuring principles, capacity planning, proceedence diagram, payment system)
4. Evaluation
5. Presentation

Requirements:

• Compact course (one week full-time)
• Limited number of participants; seats are assigned according the date of registration
• Registration via ILIAS is required
• Compulsory attendance during the whole lecture

Recommendations:

• Knowledge of Human Factors Engineering or Production Management/Industrial Engineering helpful

The students

• know planning guidelines
• know vulnerability analysis
• are able to plan work systems (e.g. technical or organisational structuring principles, capacity planning, proceedence diagram, payment system)
• are able to evaluate a planning solution
• are able to present results

Organizational issues
- Anwesenheitspflicht in Einführungsvorlesung und Blockvorlesung.
- Teilnehmerzahl beschränkt. Anmeldung über ILIAS.
- Für eine verbindliche Kursteilnahme ist die Prüfungsanmeldung bis zwei Wochen vor Veranstaltungsbeginn im ifab-Sekretariat nachzuweisen.
- mündliche Prüfung (ca. 30 Minuten)
- Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung
- Kompaktveranstaltung (eine Woche ganztägig).
- Die Vorlesung hat einen Arbeitsaufwand von 120 h (=4 LP).

Literature
Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.
### 10.347 Course: Plasticity of Metals and Intermetallics [T-MACH-110818]

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
Dr.-Ing. Alexander Kauffmann  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-102611 - Major Field: Materials Science and Engineering  

<table>
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<td>Each summer term</td>
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<td>Kauffmann, Heilmaier</td>
<td></td>
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</tbody>
</table>

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**  
oral exam (about 25 minutes)

**Prerequisites**  
T-MACH-110268 – Plastizität von metallischen und intermetallischen Werkstoffen has not been started  
T-MACH-105301 - Werkstoffkunde III has not been started

**Modeled Conditions**  
The following conditions have to be fulfilled:

1. The course T-MACH-105301 - Materials Science and Engineering III must not have been started.

**Below you will find excerpts from events related to this course:**

**Plasticity of Metals and Intermetallics**  
2173648, SS 2021, 4 SWS, Language: English, Open in study portal

**Lecture (V)**  
Online
Content
Learning Objectives
Students are familiar with macroscopic, mesoscopic and microscopic mechanisms of plastic deformation in metals, alloys and intermetallics including the qualitative and quantitative descriptions. Furthermore, students can apply their knowledge in order to deduce and explain mechanism-property relationships in this kind of materials and their use in materials manufacturing.

Content
(i) Relevance of plasticity in industry and research
(ii) Macroscopic features of plastic deformation
(iii) Fundamentals and interrelations to other lectures:
- fundamental concepts of elasticity
- macroscopic strength and strengthening/hardening
- fundamentals of crystallography
- fundamentals of defects in crystalline solids
(iv) Dislocations:
- fundamental concept
- observation of dislocations
- properties of dislocations
- dislocations in fcc metals
- dislocations in bcc metals
- dislocations in hcp metals and complex intermetallics
(v) Single crystal plasticity
- influence of temperature, orientation, strain rate, etc. (fcc metals)
- further examples (entension of the results to bcc, hcp and intermetallic materials)
- deformation twinning
(vi) Polycrystalline materials
- transition from single crystals to polycrystals
- strength of polycrystals: solute atoms, dislocations (incl. dislocation patterning), grain boundaries, precipitates and dispersoids
(vii) Other mechanisms of plastic deformation
- deformation twinning, martensitic transformation, grain boundary sliding
(viii) Summary

Work Load
lectures: 56 h
private studies: 187 h

Organizational issues
Details about the lecture are distributed via: https://www.iam.kit.edu/wk/english/studies.php

Literature
Powerpoint slides will be distributed via the ILIAS system.
Detailed information are available for different sub topics of the lecture:
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC070938105
Hull, D. J. Bacon: „Introduction to Dislocations“, Elsevier (2011)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC383083990 (free vie KIT license)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656
https://www.ifw-dresden.de/institutes/imw/events/lectures/lecture-notes/physikalische-werkstoffeigenschaften/ (public domain)
Course: PLM for Product Development in Mechatronics [T-MACH-102181]

10.348 Course: PLM for Product Development in Mechatronics [T-MACH-102181]

Responsible: Prof. Dr.-Ing. Martin Eigner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102613 - Major Field: Lifecycle Engineering

Type: Oral examination
Credits: 4
Grading scale: Grade to a third
Recurrence: Each summer term
Version: 1

Events

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Exams

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<td>Each summer term</td>
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Competence Certificate
Oral examination 20 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V PLM for product development in mechatronics
2122376, SS 2021, SWS, Language: German, Open in study portal

Content
Students are able to

• compare product data management and product lifecycle management.
• describe the components and core functions of a PLM solution
• explain trends from research and practice in the field of PLM form mechatronic product development

Organizational issues
Blockveranstaltung, Teilnehmerzahl begrenzt.

Literature
Vorlesungsfolien / lecture slides

V PLM for product development in mechatronics
2122376, WS 21/22, 2 SWS, Language: German, Open in study portal

Content
Students are able to

• compare product data management and product lifecycle management.
• describe the components and core functions of a PLM solution
• explain trends from research and practice in the field of PLM form mechatronic product development

Organizational issues
Blockveranstaltung, Zeit und Ort siehe Homepage oder ILIAS zur Lehrveranstaltung.

Literature
Vorlesungsfolien / lecture slides
10.349 Course: Plug-and-Play Material Handling [T-MACH-106693]

**Responsible:** Jonathan Auberle  
Prof. Dr.-Ing. Kai Furmans

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102591 - Laboratory Course

<table>
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<th>Grading scale</th>
<th>Recurrence</th>
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<td>pass/fail</td>
<td>Each winter term</td>
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**Responsibility:** Jonathan Auberle  
Prof. Dr.-Ing. Kai Furmans

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102591 - Laboratory Course

**Type**  
Completed coursework

**Credits**  
4

**Grading scale**  
pass/fail

**Recurrence**  
Each winter term

**Version**  
2

**Events**

| WT 21/22 2117070 | Plug-and-play material handling | 2 SWS | Practical course / Blended (On-Site/Online) | Furmans, Müller, Enke |

Legend: 🍽 Online, 🧩 Blended (On-Site/Online), 🗺 On-Site, ✗ Cancelled

**Competence Certificate**

Presentation of the four steps of the course content (design, implementation, test concept and evaluation)

**Prerequisites**

None

Below you will find excerpts from events related to this course:

**Plug-and-play material handling**

2117070, WS 21/22, 2 SWS, Language: German, Open in study portal

**Practical course (P)**

Blended (On-Site/Online)

**Content**

- Theoretical basics and structure of plug-and-play-capable material handling technology
- Practical application of the contents in teamwork using various industry-related hardware components
- Development of a heterogeneous integrated mechatronic system
- Planning and implementation of a control system using the software framework ROS and the programming language Python
- Use of a simulation environment for development and transition from simulation to real hardware
- Use of different sensor systems
- Presentation of the work results and evaluation of these on the basis of logistical key figures

The students will be able to:

- Name and explain the basics of plug-and-play conveyor technology
- Expand their knowledge of plug-and-play conveyor technology through independent research
- Apply the theory they have learned to a practical problem
- Deal with the software framework ROS (Robot Operating System)
- Evaluate developed solutions on the basis of logistical key figures

**Organizational issues**

Die Teilnehmerzahl ist beschränkt. Die Auswahl erfolgt nach einem Auswahlverfahren.

Um sich für die Teilnahme zu bewerben stellen Sie bitte einen aufnahmeantrag für den aktuellen Ilias-Kurs mit einem kurzen Bewerbungstext. Dieser sollte ihre bisherigen Erfahrungen sowie ihre Motivation für das Praktikum behalten.

Das Praktikum findet zwei Wochen in Vollzeit statt. Der genaue Zeitraum wird Anfang Frühjahr 2022 auf der Institutswebsite bekanntgegeben.

Ob die Veranstaltung online stattfinden wird oder eine Durchführung in Präsenz möglich ist, wird mit Veröffentlichung des Veranstaltungszeitraums bekannt gegeben.
10.350 Course: Polymer Engineering I [T-MACH-102137]

**Responsible:** Prof. Dr.-Ing. Peter Elsner  
Dr.-Ing. Wilfried Liebig

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102611 - Major Field: Materials Science and Engineering  
M-MACH-102628 - Major Field: Lightweight Construction  
M-MACH-102632 - Major Field: Polymer Engineering  
M-MACH-102637 - Major Field: Tribology

### Events

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<th>Credits</th>
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<td>4</td>
<td>Grade to a third</td>
<td>Each winter term</td>
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### Exams

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<td>Each winter term</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

### Competence Certificate

Oral exam, about 25 minutes

### Prerequisites

none

*Below you will find excerpts from events related to this course:*

**Polymer Engineering I**  
2173590, WS 21/22, 2 SWS, Language: German, Open in study portal  
Lecture (V)  
Blended (On-Site/Online)
Content
1. Economical aspects of polymers
2. Introduction of mechanical, chemical and electrical properties
3. Processing of polymers
   (Introduction)
4. Material science of polymers
5. Synthesis

Learning objectives:
The field of Polymer Engineering includes synthesis, material science, processing, construction, design, tool engineering, production technology, surface engineering and recycling. The aim is, to equip the students with knowledge and technical skills, and to use the material "polymer" meeting its requirements in an economical and ecological way.

The students
- are able to describe and classify polymers
- based on the fundamental synthesis processing techniques
- can find practical applications for state-of-the-art polymers and manufacturing technologies
- are able to apply the processing techniques, the application of polymers and polymer composites regarding to the basic principles of material science
- can describe the special mechanical, chemical and electrical properties of polymers and correlate these properties to the chemical bindings.
- can define application areas and the limitation in the use of polymers

Requirements:
none

Workload:
regular attendance: 21 hours
self-study: 99 hours

Organizational Issues

Literature
Literaturhinweise, Unterlagen und Teilmanuskript werden in der Vorlesung ausgegeben.
10.351 Course: Polymer Engineering II [T-MACH-102138]

**Responsible:** Prof. Dr.-Ing. Peter Elsner
Dr.-Ing. Wilfried Liebig

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102632 - Major Field: Polymer Engineering

**Type:** Oral examination
**Credits:** 4
**Grading scale:** Grade to a third
**Recurrence:** Each summer term

**Events**

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**Exams**

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**Competence Certificate**

Oral exam, about 25 minutes

**Prerequisites**

none

**Recommendation**

Knowledge in Polymerengineering I

Below you will find excerpts from events related to this course:

**Polymer Engineering II**

2174596, SS 2021, 2 SWS, Language: German, Open in study portal

Lecture (V) Online
Content
1. Processing of polymers
2. Properties of polymer components
Based on practical examples and components
2.1 Selection of material
2.2 Component design
2.3 Tool engineering
2.4 Production technology
2.5 Surface engineering
2.6 Sustainability, recycling

learning objectives:
The field of Polymer Engineering includes synthesis, material science, processing, construction, design, tool engineering, production technology, surface engineering and recycling. The aim is, that the students gather knowledge and technical skills to use the material "polymer" meeting its requirements in an economical and ecological way.
The students
  • can describe and classify different processing techniques
  • 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.
### 10.352 Course: Polymers [T-CHEMBIO-100294]

**Organisation:**  KIT Department of Chemistry and Biosciences  
**Part of:**  M-MACH-102628 - Major Field: Lightweight Construction

<table>
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#### Events

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<td>2 SWS, Lecture / Online, Wilhelm</td>
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<td>Chemie und Physik der Makromoleküle I</td>
<td>2 SWS, Lecture / Blended (On-Site/Online), Wilhelm, Dingenouts</td>
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#### Exams

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<tr>
<td>WT 21/22</td>
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<td>Wilhelm</td>
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**Legend:**  🌐 Online, 🤖 Blended (On-Site/Online), ⬆ On-Site, ✗ Cancelled
Course: Polymers in MEMS A: Chemistry, Synthesis and Applications [T-MACH-102192]

**Responsible:** Dr.-Ing. Bastian Rapp

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102616 - Major Field: Microsystem Technology

<table>
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**Exams**

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</table>

**Competence Certificate**

Oral examination

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

**Polymers in MEMS A: Chemistry, Synthesis and Applications**

2141853, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Blended (On-Site/Online)**

**Organizational issues**

Findet als Blockveranstaltung am Semesterende statt.
10 COURSES

Course: Polymers in MEMS B: Physics, Microstructuring and Applications [T-MACH-102191]

**Responsible:** Dr.-Ing. Matthias Worgull

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102616 - Major Field: Microsystem Technology

**Type**
- Oral examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each winter term

**Version**
- 1

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**Legend:**
- 🖥 Online
- 🧩 Blended (On-Site/Online)
- 🗻 On-Site
- ✗ Cancelled

**Competence Certificate**
- Oral examination

**Prerequisites**
- none

Below you will find excerpts from events related to this course:

**Polymers in MEMS B: Physics, Microstructuring and Applications**
- 2141854, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)
- Lecture (V) Blended (On-Site/Online)
Below you will find excerpts from events related to this course:

### Polymers in MEMS C - Biopolymers and Bioplastics

**2142855, SS 2021, 2 SWS, Language: German, Open in study portal**

Blended (On-Site/Online)

**Content**

Polymers are ubiquitous in everyday life: from packaging materials all the way to specialty products in medicine and medical engineering. Today it is difficult to find a product which does not (at least in parts) consist of polymeric materials. The question of how these materials can be improved with respect to their disposal and consumption of (natural) resources during manufacturing is often raised. Today polymers must be fully recycled in Germany and many other countries due to the fact that they do not (or only very slowly) decompose in nature. Furthermore significant reductions of crude oil consumption during synthesis are of increasing importance in order to improve the sustainability of this class of materials. With respect to disposal polymers which do not have to be disposed by combustion but rather allow natural decomposition (composting) are of increasing interest. Polymers from renewable sources are also of interest for modern microelectromechanical systems (MEMS) especially if the systems designed are intended as single-use products.

This lecture will introduce the most important classes of these so-called biopolymers and bioplastics. It will also discuss and highlight polymers which are created from naturally created analogues (e.g. via fermentation) to petrochemical polymer precursors and describe their technical processing. Numerous examples from MEMS as well as everyday life will be given.

Some of the topics covered are:

- What are biopolyurethanes and how can you produce them from castor oil?
- What are "natural glues" and how are they different from chemical glues?
- How do you make tires from natural rubbers?
- What are the two most important polymers for life on earth?
- How can you make polymers from potatoes?
- Can wood be formed by injection molding?
- How do you make buttons from milk?
- Can you play music on biopolymers?
- Where and how do you use polymers for tissue engineering?
- How can you build LEGO with DNA?

The lecture will be given in German language unless non-German speaking students attend. In this case, the lecture will be given in English (with some German translations of technical vocabulary). The lecture slides are in English language and will be handed out for taking notes. Additional literature is not required.

For further details, please contact the lecturer, **PD Dr.-Ing. Matthias Worgull (matthias.worgull@kit.edu)**. Preregistration is not necessary.
Organizational issues
Für weitere Rückfragen, wenden Sie sich bitte an PD Dr.-Ing- Matthias Worgull (matthias.worgull@kit.edu). Eine Voranmeldung ist nicht notwendig.

Literature
Zusätzliche vorlesungsbegleitende Literatur ist nicht notwendig.
**10.356 Course: Powertrain Systems Technology A: Automotive Systems [T-MACH-105233]**

**Responsible:** Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Sven Matthiesen  
Sascha Ott

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102599 - Major Field: Powertrain Systems  
- M-MACH-102605 - Major Field: Engineering Design  
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics  
- M-MACH-102607 - Major Field: Vehicle Technology  
- M-MACH-102637 - Major Field: Tribology

**Type** | **Credits** | **Grading scale** | **Recurrence** | **Version**  
--- | --- | --- | --- | ---  
Written examination | 4 | Grade to a third | Each summer term | 2

**Events**

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<td>Albers, Ott</td>
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**Exams**

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<th>Grading scale</th>
<th>Recurrence</th>
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<tr>
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<td>Powertrain Systems Technology A: Automotive Systems</td>
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<td>76-T-MACH-105233</td>
<td>Powertrain Systems Technology A: Automotive Systems</td>
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<td>Albers, Ott</td>
</tr>
</tbody>
</table>

*Legend:* 🖥 Online, 🧩 Blended (On-Site/Online), ⚰ On-Site, ✗ Canceled

**Competence Certificate**

written examination: 60 min duration

**Prerequisites**

None

*Below you will find excerpts from events related to this course:*

**Powertrain Systems Technology A: Automotive Systems**

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<thead>
<tr>
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<tr>
<td>2146180</td>
<td>Powertrain Systems Technology A: Automotive Systems</td>
<td>2 SWS</td>
<td>Lecture (V)</td>
<td>German</td>
<td>Open in study portal</td>
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</table>

**Content**

Students acquire the basic skills needed to develop future energy-efficient and at the same time comfortably drivable powertrains. This includes holistic development methods and evaluations of powertrain systems. The main topics can be divided into the following chapters:

- Powertrain System  
- Driver System  
- Environment System  
- System Components  
- Development Process

**Recommendations for additional courses:**

- Power Train Systems Technology B: Stationary Machinery

**Literature**

Kirchner, E., "Leistungsübertragung in Fahrzeuggetrieben: Grundlagen der Auslegung, Entwicklung und Validierung von Fahrzeuggetrieben und deren Komponenten", Springer Verlag Berlin Heidelberg 2007

Naunheimer, H., "Fahrzeuggetriebe: Grundlagen, Auswahl, Auslegung und Konstruktion", Springer Verlag Berlin Heidelberg 2007
10.357 Course: Powertrain Systems Technology B: Stationary Machinery [T-MACH-105216]

Responsible:  
Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Sven Matthiesen  
Sascha Ott

Organisation: KIT Department of Mechanical Engineering

Part of:  
M-MACH-102599 - Major Field: Powertrain Systems  
M-MACH-102605 - Major Field: Engineering Design  
M-MACH-102633 - Major Field: Robotics

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Events

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Exams

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<td>Powertrain Systems Technology B: Stationary Machinery</td>
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<td>Powertrain Systems Technology B: Stationary Machinery</td>
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Legend:  
🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate

written examination: 60 min duration

Prerequisites

None

Below you will find excerpts from events related to this course:

Powertrain Systems Technology B: Stationary Machinery  
2145150, WS 21/22, 2 SWS, Language: German, Open in study portal

Content

Students acquire the basic skills needed to develop future energy-efficient and safe drive system solutions for use in industrial environments. The course considers holistic development methods and evaluations of drive systems. The focal points can be divided into the following chapters:

- Powertrain System  
- Operator System  
- Environment System  
- System Components  
- Development Process

Recommendations:

- Powertrain Systems Technology A: Automotive Systems

Literature

VDI-2241: "Schaltare fremdbetätigte Reibkupplungen und -bremsen", VDI Verlag GmbH, Düsseldorf  
Course: Practical Aspects of Electrical Drives [T-ETIT-100711]

**Responsible:** Dr.-Ing. Klaus-Peter Becker

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

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**Exams**

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**Prerequisites**

none
10.359 Course: Practical Course “Tribology” [T-MACH-105813]

Responsible: Prof. Dr. Martin Dienwiebel
Dr.-Ing. Johannes Schneider

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course
M-MACH-102637 - Major Field: Tribology

Events

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Exams

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Competence Certificate

The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Prerequisites

none

Recommendation

The attendance to one of the course Tribology (2181114) is strongly recommended!

Below you will find excerpts from events related to this course:

Praktikum "Tribologie"

2182115, SS 2021, 3 SWS, Language: German, Open in study portal

Practical course (P)
Blended (On-Site/Online)

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 strongly 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 09.04.2021 an johannes.schneider@kit.edu

Das Praktikum soll am Campus Süd (MZE, 30.48) vom 26.07. bis 30.07.2021 stattfinden.
Literature
10.360 Course: Practical Course Polymers in MEMS [T-MACH-105556]

Responsible: Dr.-Ing. Bastian Rapp  
Dr.-Ing. Matthias Worgull  

Organisation: KIT Department of Mechanical Engineering  

Part of: M-MACH-102616 - Major Field: Microsystem Technology

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Events

| ST 2021 2142856 | Practical Course Polymers in MEMS | 2 SWS | Block / 🧩 | Worgull |

Legend: Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate

The practical course will close with an oral examination. There will be only passed and failed results, no grades.

Prerequisites

none

Below you will find excerpts from events related to this course:

Practical Course Polymers in MEMS

2142856, SS 2021, 2 SWS, Language: German, Open in study portal

Block (B)  
Blended (On-Site/Online)

Content

This practical course complements the lectures "Polymers in MEMS A", "Polymers in MEMS B" and "Polymers in MEMS C" and will allow students to gain a deeper understanding of polymers and their processing. During the course of this practical course, various polymers will be synthesized and molded into components suitable for microelectromechanical systems (MEMS) applications. The aim of the course is to bring a polymer all the way from synthesis to application.

The practical course will be given in German language unless non-German speaking students attend. In this case, the course will be given in English (with some German translations of technical vocabulary). Lecture notes for the experiments are in English language and will be handed out to the students. The practical course will be held "en block" at the end of the semester (presumably beginning of October).

For further details, please contact PD Dr.-Ing. Matthias Worgull (matthias.worgull@kit.edu). Preregistration is mandatory. The number of participants is limited to 5 students.

Organizational issues

Anmeldung und Terminabsprache in der Vorlesung (2142855)

Für weitere Rückfragen, wenden Sie sich bitte an PD Dr.-Ing- Matthias Worgull (matthias.worgull@kit.edu). Eine Voranmeldung ist notwendig. Die Platzanzahl ist auf 5 Teilnehmer beschränkt.

Literature

Vorlesungsunterlagen, dort empfohlene Literatur
10.361 Course: Practical Course Technical Ceramics [T-MACH-105178]

Responsible: Dr. Günter Schell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

<table>
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Events

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<td>Practical Course Technical Ceramics</td>
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<td>76-T-MACH-105178</td>
<td>Practical Course Technical Ceramics</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Colloquium and laboratory report for the respective experiments.

Prerequisites
none

Below you will find excerpts from events related to this course:

Practical Course Technical Ceramics
2125751, WS 21/22, 2 SWS, Language: German, Open in study portal

Organizational issues
Elektronisch über das ILIAS-Portal

Literature
Richerson, D. R.: Modern Ceramic Engineering, CRC Taylor & Francis, 2006
Course: Practical Training in Basics of Microsystem Technology [T-MACH-102164]

**Responsible:** Dr. Arndt Last  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102615 - Major Field: Medical Technology  
M-MACH-102616 - Major Field: Microsystem Technology

<table>
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**Events**

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<th>Recurrence</th>
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<td>2 SWS</td>
<td>Practical course / Online</td>
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<td>2 SWS</td>
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<td>Introduction to Microsystem Technology - Practical Course</td>
<td>2 SWS</td>
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**Legend:**  
Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**  
The assessment consists of a written exam

**Prerequisites**  
none

_Below you will find excerpts from events related to this course:_

**Introduction to Microsystem Technology - Practical Course**  
2143875, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**

In the practical training includes nine experiments:

1. Hot embossing of plastics micro structures  
2. Micro electroforming  
3. Mikro optics: "LIGA-micro spectrometer"  
4. UV-lithography  
5. Optical waveguides  
6. Capillary electrophoresis on a chip  
7. SAW gas sensor  
8. Metrology  
9. Atomic force microscopy  

Each student takes part in only five experiments. The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

**Organizational issues**

Teilnahmeanfragen an Frau Nowotny, marie.nowotny@kit.edu

**Literature**

Menz, W., Mohr, J.: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 1997  
Unterlagen zum Praktikum zur Vorlesung 'Grundlagen der Mikrosystemtechnik'
### Content
In the practical training includes nine experiments:
1. Hot embossing of plastics micro structures
2. Micro electroforming
3. Mikro optics: "LIGA-micro spectrometer"
4. UV-lithography
5. Optical waveguides
6. Capillary electrophoresis on a chip
7. SAW gas sensor
8. Metrology
9. Atomic force microscopy

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### Organizational issues

Teilnahmeanfragen an Frau Nowotny, marie.nowotny@kit.edu

### Literature
Menz, W., Mohr, J.: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 1997
Unterlagen zum Praktikum zur Vorlesung 'Grundlagen der Mikrosystemtechnik'
10.363 Course: Practical Training in Measurement of Vibrations [T-MACH-105373]

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102591 - Laboratory Course
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-104443 - Major Field: Vibration Theory

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**Events**

| ST 2021 | 2162208 | Schwingungstechnisches Praktikum | Practical course / Fidlin, Bitner |

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<td>ST 2021</td>
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**Competence Certificate**
Colloquium to each session, 10 out of 10 colloquiums must be passed

**Prerequisites**
Can not be combined with Experimental Dynamics (T-MACH-105514).

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-105514 - Experimental Dynamics must not have been started.

**Recommendation**
Vibration Theory, Mathematical Methods of Vibration Theory, Dynamic Stability, Nonlinear Vibrations
Course: Principles of Ceramic and Powder Metallurgy Processing [T-MACH-102111]

**Responsible:** Dr. Günter Schell  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102611 - Major Field: Materials Science and Engineering  
- M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

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**Exams**

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<td>Lecture (V)</td>
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**Competence Certificate**

The assessment consists of an oral exam (20-30 min) taking place at the agreed date. The re-examination is offered upon agreement.

**Prerequisites**

none

**Below you will find excerpts from events related to this course:**

**Basic principles of powder metallurgical and ceramic processing**

2193010, WS 21/22, 2 SWS, Language: German, Open in study portal

**Literature**

- R.M. German: "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005  
10.365 Course: Principles of Medicine for Engineers [T-MACH-105235]

**Responsible:** apl. Prof. Dr. Christian Pylatiuk  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102615 - Major Field: Medical Technology

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<th>2 SWS</th>
<th>Lecture / Online</th>
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<td>Principles of Medicine for Engineers</td>
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<td>Principles of Medicine for Engineers</td>
<td></td>
<td>Pylatiuk</td>
<td></td>
</tr>
</tbody>
</table>

**Competence Certificate**
Written examination (Duration: 45min)

**Prerequisites**
none

Below you will find excerpts from events related to this course:

**Principles of Medicine for Engineers**  
2105992, WS 21/22, 2 SWS, Language: German, Open in study portal

**Content**

**Content:**
- Introduction: Definitions of "health" and "disease". History of medicine and paradigm shift towards evidence based medicine and personalized medicine.
- Special topics: nervous system, saltatory conduction, musculoskeletal system, cardio-circulatory system, narcotics, 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.
# 10.366 Course: Probability Theory and Statistics [T-MATH-109620]

**Responsible:** Prof. Dr. Daniel Hug  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- M-MACH-102594 - Mathematical Methods  
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering  
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology  
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

<table>
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<td>Each term</td>
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## Exams

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<td>7700067</td>
<td>Probability Theory and Statistics</td>
<td>Müller-Harknett</td>
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</table>

**Competence Certificate**  
Written exam (90 min.)

**Prerequisites**  
None
10 COURSES

Course: Process Simulation in Forming Operations [T-MACH-105348]

10.367 Course: Process Simulation in Forming Operations [T-MACH-105348]

Responsible: Dr.-Ing. Dirk Helm
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102646 - Major Field: Applied Mechanics

Type: Oral examination
Credits: 4
Grading scale: Grade to a third
Recurrence: Each winter term
Version: 1

Events

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<th>Grading scale</th>
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<td>2 SWS</td>
<td>Lecture / Blended (On-Site/Online)</td>
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</table>

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
oral exam, 20 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

Process Simulation in Forming Operations
2161501, WS 21/22, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content
Based on basics of continuum mechanics, material theory and numerics the lecture gives an introduction into the simulation of forming operations for metals

- plasticity for metallic materials: dislocations, twinning, phase transformations, anisotropy, hardening
- classification of forming operations and discussion of selected topics
- basics of tensor algebra and tensor analysis
- continuum mechanics: kinematics, finite deformations, balance laws, thermodynamics
- material theory: basics, modelling concepts, plasticity and visco plasticity, yield functions (von Mises, Hill, ...), kinematic and isotropic hardening, damage
- thermomechanical coupling
- modelling of contact
- finite element method: explicit and implicit formulations, types of elements, numerical integration of material models
- process simulation of selected problems of sheet metal forming

**Responsible:** Dr. Stefan Kienzle  
Dr. Dieter Steegmüller

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102607 - Major Field: Vehicle Technology  
- M-MACH-102618 - Major Field: Production Technology  
- M-MACH-102628 - Major Field: Lightweight Construction

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**Events**

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<th>Recurrence</th>
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<tr>
<td>WT 21/22</td>
<td>2149670</td>
<td>Product- and Production-Concepts for modern Automobiles</td>
<td>2 SWS</td>
<td>Lecture / 🧩</td>
<td>Steegmüller, Kienzle</td>
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**Exams**

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<th>Version</th>
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<td>76-T-MACH-110318</td>
<td>Product- and Production-Concepts for modern Automobiles</td>
<td>Steegmüller, Kienzle</td>
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</table>

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🔔 On-Site, ✗ Cancelled

**Competence Certificate**

Oral Exam (20 min)

**Prerequisites**

T-MACH-105166 - Materials and Processes for Body Lightweight Construction in the Automotive Industry must not have been started.

Below you will find excerpts from events related to this course:

**Product- and Production-Concepts for modern Automobiles**

<table>
<thead>
<tr>
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<th>Grading scale</th>
<th>Recurrence</th>
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</table>

2149670, WS 21/22, 2 SWS, Language: German, Open in study portal
Content
The lecture illuminates the practical challenges of modern automotive engineering. As former leaders of the automotive industry, the lecturers refer to current aspects of automotive product development and production.

The aim is to provide students with an overview of technological trends in the automotive industry. In this context, the course also focuses on changes in requirements due to new vehicle concepts, which may be caused by increased demands for individualisation, digitisation and sustainability. The challenges that arise in this context will be examined from both a production technology and product development perspective and will be illustrated with practical examples thanks to the many years of industrial experience of both lecturers.

The topics covered are:

- General conditions for vehicle and body development
- Integration of new drive technologies
- Functional requirements (crash safety etc.), also for electric vehicles
- Development Process at the Interface Product & Production, CAE/Simulation
- Energy storage and supply infrastructure
- Aluminium and lightweight steel construction
- FRP and hybrid parts
- Battery, fuel cell and electric motor production
- Joining technology in modern car bodies
- Modern factories and production processes, Industry 4.0.

Learning Outcomes:
The students ...

- are able to name the presented general conditions of vehicle development and are able to discuss their influences on the final product using practical examples.
- are able to name the various lightweight approaches and identify possible areas of application.
- are able to identify the different production processes for manufacturing lightweight structures and explain their functions.
- are able to perform a process selection based on the methods and their characteristics.

Workload:
regular attendance: 25 hours
self-study: 95 hours

Organizational issues
Termine werden über Ilias bekannt gegeben.
Bei der Vorlesung handelt es sich um eine Blockveranstaltung. Eine Anmeldung über Ilias ist erforderlich.
The lecture is a block course. An application in Ilias is mandatory.

Literature
Medien:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
Course: Product Development - Dimensioning of Components [T-MACH-105383]

Responsible: Dr.-Ing. Stefan Dietrich
Prof. Dr.-Ing. Volker Schulze

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102593 - Product Development - Dimensioning of Components

Type: Written examination
Credits: 7
Grading scale: Grade to a third
Recurrence: Each summer term
Version: 1

Events
ST 2021 2150511 Product Development - Component Dimensioning 3 / 1 SWS Lecture / Practice ( / Schulze, Dietrich

Exams
ST 2021 76-T-MACH-105383 Product Development - Dimensioning of Components Schulze

Competence Certificate
written exam (2 hours)

Prerequisites
none

Below you will find excerpts from events related to this course:

Product Development - Component Dimensioning
2150511, SS 2021, 3 / 1 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
Blended (On-Site/Online)

Content
The aim of the lecture is to present the topics of the dimensioning and the material science in their connection and to learn how to deal with corresponding methods and the combination thereof.

For the prospective engineer the most important educational objective is to understand the interaction of these topics while the interplay of the individual material stresses in the component are clarified.

The topics in detail are:

- Structural dimensioning: basic stresses, superimposed stresses, notch influence, fatigue limit, fatigue strength, assessment of cracked components, operational strength, residual stresses, high temperature stress and corrosion
- Material selection: Basics, material indices, material selection diagrams, Ashby procedure, multiple boundary conditions, target conflicts, shape and efficiency.

Learning target: The students…
- are capable to design and dimension components according to their load.
- can include mechanical material properties from the mechanical material test in the dimensioning process.
- can identify superimposed total loads and critical loads on simple components and to compute them.
- acquire the skill to select materials based on the application area of the components and respective loads.

Examination: written exam (2 hours)

Literature
Vorlesungsskript
**10.370 Course: Product Lifecycle Management [T-MACH-105147]**

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering  
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology  
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction  
M-MACH-102742 - Fundamentals and Methods of Production Technology

**Events**

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<td>Grade to a third</td>
<td>Each winter term</td>
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**Exams**

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<td>WT 21/22</td>
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<td>Product Lifecycle Management</td>
<td>2 SWS</td>
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<td>Ovtcharova, Elstermann</td>
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<td>76-T-MACH-105147</td>
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<td>76-T-MACH-105147</td>
<td>Product Lifecycle Management</td>
<td>Ovtcharova</td>
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</table>

**Competence Certificate**  
Written examination 90 min.

**Prerequisites**  
None

*Below you will find excerpts from events related to this course:*

**Product Lifecycle Management**  
2121350, WS 21/22, 2 SWS, Language: German, Open in study portal

**Content**  
The course includes:

- Basics for product data management and data exchange  
- IT system solutions for Product Lifecycle Management (PLM)  
- Economic viability analysis and implementation problems  
- Illustrative scenario for PLM using the example of the institute's own I4.0Lab

After successful attendance of the course, students can:

- identify the challenges of data management and exchange and describe solution concepts for these challenges.  
- clarify the management concept PLM and its goals and highlight the economic benefits.  
- explain the processes required to support the product life cycle and describe the most important business software systems (PDM, ERP, ...) and their functions.


**Literature**

Vorlesungsfolien.


10.371 Course: Product, Process and Resource Integration in the Automotive Industry [T-MACH-102155]

Responsible: Prof. Dr.-Ing. Sama Mbang
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102607 - Major Field: Vehicle Technology

<table>
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<td>Grade to a third</td>
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Events

| ST 2021  | 2123364 | Product, Process and Resource Integration in the Automotive Industry | 2 SWS | Lecture / 📖 | Mbang |

Exams

| ST 2021  | 76-T-MACH-102155 | Product, Process and Resource Integration in the Automotive Industry | Mbang |

Legend: 📖 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate
Oral examination 20 min.

Prerequisites
None

Annotation
Limited number of participants.

Below you will find excerpts from events related to this course:

Product, Process and Resource Integration in the Automotive Industry
2123364, SS 2021, 2 SWS, Language: German, Open in study portal

Content

- Overview of product development in the automotive sector (process- and work cycle, IT-Systems)
- Integrated product models in the automotive industry (product, process and resource)
- New CAx modeling methods (intelligent feature technology, templates & functional modeling)
- Automation and knowledge-based mechanism for product design and production planning
- Product development in accordance with defined process and requirement (3D-master principle, tolerance models)
- Concurrent Engineering, shared working
- Enhanced concepts: the digital and virtual factory (application of virtual technologies and methods in the product development)

Organizational issues
Blockveranstaltung

Literature
Vorlesungsfolien
10.372 Course: Production Planning and Control [T-MACH-105470]

**Responsible:** Dr.-Ing. Andreas Rinn  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102600 - Major Field: Man - Technology - Organisation  
M-MACH-102618 - Major Field: Production Technology

<table>
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**Events**

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<th>Rinn</th>
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<td>2110032</td>
<td>Production Planning and Control</td>
<td>2 SWS /</td>
<td>Rinn</td>
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</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**
written exam 60 minutes (if the number of participants is low, the examination is oral, 20 minutes)

**Prerequisites**
Timely pre-registration in ILIAS, since participation is limited.

**Below you will find excerpts from events related to this course:**

**Production Planning and Control**  
2110032, SS 2021, 2 SWS, Language: German, Open in study portal  
Cancelled

**Content**

1. Goals and recommendations for production planning and control  
2. Strategies for work control  
3. Case study: Manufacturing of bicycles  
4. FASI-Plus: Simulation of a bicycle factory for the production planning and control  
5. Simulation of the order processing  
6. Decision making about order control and procurement of purchased parts  
7. Evaluation of the simulation protocols  
8. Realisation of production planning and control

**Requirements:**

- Compact course  
- Limited number of participants; seats are assigned according the date of registration  
- Registration via ILIAS is required  
- Compulsory attendance during the whole lecture

**Recommendations:**

- Knowledge in Production Management/Industrial Engineering is required  
- Knowledge of Work Science and Economics is helpful  
- Knowledge of Informatics is not required, but helpful

**Learning targets:**

- Lerninhalte zum Thema "Produktionsmanagement" vertiefen  
- Kenntnisse über die Produktionsplanung und -steuerung erweitern  
- Grundlegende Techniken der Modellierung und Simulation von Produktionssystemen verstehen

**Organizational issues**

Die Vorlesung "Produktionsplanung und -steuerung" wird aufgrund der momentanen Situation für dieses Sommersemester nochmal abgesagt und regulär auf das nächste Wintersemester gelegt.
**Content**

1. Goals and recommendations for production planning and control
2. Strategies for work control
3. Case study: Manufacturing of bicycles
4. FASI-Plus: Simulation of a bicycle factory for the production planning and control
5. Simulation of the order processing
6. Decision making about order control and procurement of purchased parts
7. Evaluation of the simulation protocols
8. Realisation of production planning and control

**Requirements:**

- Compact course
- Limited number of participants; seats are assigned according the date of registration
- Registration via ILIAS is required
- Compulsory attendance during the whole lecture

**Recommendations:**

- Knowledge in Production Management/Industrial Engineering is required
- Knowledge of Work Science and Economics is helpful
- Knowledge of Informatics is not required, but helpful

**Learning targets:**

- Lerninhalte zum Thema "Produktionsmanagement" vertiefen
- Kenntnisse über die Produktionsplanung und -steuerung erweitern
- Grundlegende Techniken der Modellierung und Simulation von Produktionssystemen verstehen

**Organizational issues**

- Anwesenheitspflicht in Einführungsveranstaltung und Blockvorlesung.
- Teilnehmerzahl ist beschränkt.
- Für eine verbindliche Kursteilnahme ist die Prüfungsanmeldung bis zwei Wochen vor Veranstaltungsbeginn im ifab-Sekretariat nachzuweisen.
- die Prüfung ist schriftlich, außer es sind zuwenig Teilnehmer, dann mündlich
- Die Vorlesung hat einen Arbeitsaufwand von 120 h (=4 LP).

**Literature**

Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.
10.373 Course: Production Techniques Laboratory [T-MACH-105346]

**Responsible:** Prof. Dr.-Ing. Barbara Deml  
Prof. Dr.-Ing. Jürgen Fleischer  
Prof. Dr.-Ing. Kai Furmans  
Prof. Dr.-Ing. Jivka Ovtcharova  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102591 - Laboratory Course  
M-MACH-102618 - Major Field: Production Technology  
M-MACH-102629 - Major Field: Logistics and Material Flow Theory

<table>
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<td>Practical course / Online</td>
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<td>ST 2021 76-T-MACH-105346</td>
<td>Production Techniques Laboratory</td>
<td></td>
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<td>Deml, Furmans, Ovtcharova, Schulze</td>
</tr>
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</table>

**Competence Certificate**  
**Advanced Internship:** Participate in practical exercise courses and complete the colloquia successfully.

**Elective Subject:** Participate in practical exercise courses and complete the colloquia successfully and presentation of a specific topic.

**Prerequisites**  
None

*Below you will find excerpts from events related to this course:*
Content
The production technique laboratory (PTL) is a collaboration of the institutes wbk, IFL, IMI and ifab.

1. Computer Aided Product Development (IMI)
2. Computer communication in factory (IMI)
3. Production of parts with CNC turning machines (wbk)
4. Controlling of production systems using PLCs (wbk)
5. Automated assembly systems (wbk)
6. Optical identification in production and logistics (IFL)
7. RFID identification systems (IFL)
8. Storage and order-picking systems (IFL)
9. Production Management (ifab)
10. Time study (ifab)
11. Accomplishment of workplace design (ifab)

Recommendations:
Participation in the following lectures:

- Informationssystems in logistics and supply chain management
- Material flow in logistic systems
- Manufacturing technology
- Human Factors Engineering

Learning Objects:
The students acquire in the lab profound knowledge about the scientific theories, principles and methods of Production Engineering. Afterwards they are able to evaluate and design complex production systems according to problems of manufacturing and process technologies, materials handling, handling techniques, information engineering as well as production organisation and management.

After completion this lab, the students are able:

- to analyse and solve planning and layout problems of the discussed fields,
- to evaluate and configure the quality and efficiency of production, processes and products,
- to plan, control and evaluate the production of a production enterprise,
- to configure and evaluate the IT architecture of a production enterprise,
- to design and evaluate appropriate techniques for conveying, handling and picking within a production system,
- to design and evaluate the part production and the assembly by considering the work processes and the work places.

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.

Literature
Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.
10.374 Course: Production Technology for E-Mobility [T-MACH-110984]

**Responsible:** Prof. Dr.-Ing. Jürgen Fleischer  
Dr.-Ing. Janna Ruhland

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102599 - Major Field: Powertrain Systems  
- M-MACH-102605 - Major Field: Engineering Design  
- M-MACH-102607 - Major Field: Vehicle Technology  
- M-MACH-102618 - Major Field: Production Technology  
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology

<table>
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<th>Version</th>
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<td>Each summer term</td>
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**Events**

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<td>Production Technology for E-Mobility</td>
<td>2 SWS</td>
<td>Lecture / 🖥</td>
<td>Fleischer, Ruhland</td>
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**Exams**

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<th>Duration</th>
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<td>Fleischer</td>
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**Competence Certificate**

Written Exam (60 min)

**Prerequisites**

none

**Below you will find excerpts from events related to this course:**

**Production Technology for E-Mobility**  
2150605, SS 2021, 2 SWS, Language: German, Open in study portal

**Lecture (V)**  
Online

**Content**

In the lecture Production Engineering for Electromobility the students should be enabled to design, select and develop production processes for the production of the components of an electric drive train (electric motor, battery cells, fuel cells) by using research-oriented teaching.

**Learning Outcomes:**

The students are able to:

- describe the structure and function of a fuel cell, an electric traction drive and a batteriesystem.  
- reproduce the process chains for the production of the components fuel cell, battery and electric traction drive.  
- apply methodical tools to solve problems along the process chain.  
- derive the challenges in the production of electric drives for electric mobility.  
- describe the factors influencing the individual process steps on each other using the process chain of Li-ion battery cells.  
- enumerate or describe the necessary process parameters to counteract the influencing factors of the process steps in Li-ion battery cell production.  
- apply methodical tools to solve problems along the process chain for the production of Li-ion battery cells.  
- derive the challenge of mounting and dismounting battery modules.  
- derive the challenges in the production of fuel cells for use in mobility.

**Workload:**

regular attendance: 42 hours  
self-study: 78 hours

**Organizational issues**

Die Lehrveranstaltung wird erstmalig im Sommersemester 2021 angeboten.
Literature
Skript zur Veranstaltung wird über Ilias (https://lias.studium.kit.edu/) bereitgestellt.
Lecture notes will be provided in Ilias (https://lias.studium.kit.edu/)
10.375 Course: Productivity Management in Production Systems [T-MACH-105523]

Responsible: Prof. Dr. Sascha Stowasser
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102600 - Major Field: Man - Technology - Organisation
- M-MACH-102613 - Major Field: Lifecycle Engineering
- M-MACH-102618 - Major Field: Production Technology
- M-MACH-102629 - Major Field: Logistics and Material Flow Theory

Type
Oral examination
Credits
4
Grading scale
Grade to a third
Recurrence
Each summer term
Version
1

Events

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Exams

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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
oral exam (approx. 30 min)
The exam is offered in German only!

Prerequisites
none

Below you will find excerpts from events related to this course:

Productivity Management in Production Systems
2110046, SS 2021, 2 SWS, Language: German, Open in study portal Cancelled

Content

1. Definition and terminology of process design and industrial engineering
2. Tasks of industrial engineering
3. Actual approaches of organisation of production (Holistic production systems, Guided group work et al.)
4. Methods and principles of industrial engineering and production systems
5. Case studies and exercises for process design
6. Industry 4.0

Requirements:

- Compact course (one week full-time)
- Limited number of participants; seats are assigned according the date of registration
- Registration via ILIAS is required
- Compulsory attendance during the whole lecture

Recommendations:

- Knowledge of work science is helpful

Learning objective:

- Ability to design work operations and processes effectivelly and efficiently
- Instruction in methods of time study (MTM, Data acquisition etc.)
- Instruction in methods and principles of process design
- The Students are able to apply methods for the design of workplaces, work operations and processes.
- The Students are able to apply actual approaches of process and production organisation.
Organizational issues
Da das ganze Sommersemester 2021 komplett digital stattfinden soll, muss diese Präsenzveranstaltung leider abgesagt werden.

Literature
Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.
10.376 Course: Programming in CAE-Applications [T-MACH-111431]

**Responsible:** Dr.-Ing. Luise Kärger  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102605 - Major Field: Engineering Design  
- M-MACH-102611 - Major Field: Materials Science and Engineering  
- M-MACH-102628 - Major Field: Lightweight Construction  
- M-MACH-102632 - Major Field: Polymer Engineering

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**Events**

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<td>2 SWS</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗂 On-Site, ☑ Cancelled

**Competence Certificate**
Colloquia on exercises during the semester and presentation of a group task at the end of the semester (ungraded)

**Prerequisites**
The number of participating students is limited. Details for the admission process can be found in the category "Organizational issues" of the associated event.

**Recommendation**
- Basics of the finite element method (ideally with Abaqus)
- Basic knowledge of continuum mechanics
- Basics of programming
- Basic knowledge of fibre-reinforced polymers

_Below you will find excerpts from events related to this course:_

**Programming in CAE-Applications**  
2113109, WS 21/22, 2 SWS, Language: German, Open in study portal

**Practical course (P)**  
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


The room allocation and the weekly course date will be announced at the beginning of the winter semester on the Institute's homepage (https://www.fast.kit.edu/lbt/1205.php).

Due to the desired supervision ratio and the institute's equipment, the maximum number of participating students is limited. Preliminary registration takes place via the associated form on the Institute's homepage (https://www.fast.kit.edu/lbt/1205.php), which will be published there together with further details at the beginning of September. If there are too many interested students, a selection will take place among all interested students.
10.377 Course: Project Internship Additive Manufacturing: Development and Production of an Additive Component [T-MACH-110960]

Responsible: Dr.-Ing. Frederik Zanger
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102605 - Major Field: Engineering Design
- M-MACH-102611 - Major Field: Materials Science and Engineering
- M-MACH-102615 - Major Field: Medical Technology
- M-MACH-102618 - Major Field: Production Technology
- M-MACH-102628 - Major Field: Lightweight Construction

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Exams

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<td>Practical course / Zanger</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Canceled

Competence Certificate

Alternative test achievement (graded):
- Milestone based presentation of the results in presentation form (10 min) and submitting of the presentation file with weighting 30%
- Oral exam (15 min) with weighting 40%
- Project work with weighting 30%

Prerequisites

none

Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-110983 - Project Internship Additive Manufacturing: Development and Production of an Additive Component must not have been started.

Below you will find excerpts from events related to this course:
Content
The lecture "Project Internship Additive Manufacturing: Development and Production of an Additive Component" combines the basics of metallic laser powder bed fusion (LPBF) with a development project in cooperation with an industrial company. The students learn the basics of the following topics in the project-related lecture:

- Influence of different process variables on the component quality of parts produced in the LPBF process
- Preparation and simulation of the LPBF process
- Production of additive metallic components
- Process monitoring and quality assurance in additive manufacturing
- Topology optimization
- CAM for subtractive rework

The topics addressed in the course will be applied practically in various workshops on the individual topics and transferred to the developmental task in self-study. Finally, the results of the elaborations are produced additively and post-processed subtractively.

Learning Outcomes:
The students ...

- are able to describe the properties and applications of the additive manufacturing processes laser powder bed fusion (LPBF) and lithography assisted ceramic manufacturing (LCM).
- are able to select the appropriate manufacturing process for a technical application.
- are able to describe and implement the creation of a product along the entire additive process chain (CAD, simulation, work preparation, CAM) from the idea to the production.
- are able to discuss the development process for components that are optimized for additive manufacturing.
- are able to perform topology optimization.
- are able to simulate the additive process, compensate for process-related distortions and determine the ideal alignment on the building platform.
- are able to create necessary support structures for the additive process and to derive a building order file.
- are able to create a CAM model for the subtractive rework process of additive parts.

Workload:
regular attendance: 12 hours
self-study: 108 hours

Organizational issues
Termine werden über Ilias bekannt gegeben.
Bei der Vorlesung handelt es sich um eine Blockveranstaltung.
Eine Anmeldung über Ilias ist erforderlich.
Dates will be announced via Ilias.
The lecture is a block event.
A registration via Ilias is required.

Literature
Skript zur Veranstaltung wird über Ilias (https://ilias.studium.kit.edu/) bereitgestellt
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)
10 COURSES

10.378 Course: Project Internship Additive Manufacturing: Development and Production of an Additive Component [T-MACH-110983]

Responsible: Dr.-Ing. Frederik Zanger
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102591 - Laboratory Course

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Events

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Exams

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</table>

Competence Certificate

Alternative Achievement (oral):

- Milestone based presentation of the results in presentation form (10 min) and submitting of the presentation file with weighting 30%
- Oral success control (15 min) with weighting 40%
- Project work with weighting 30%

Prerequisites

none

Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-110960 - Project Internship Additive Manufacturing: Development and Production of an Additive Component must not have been started.

Below you will find excerpts from events related to this course:

Project Internship Additive Manufacturing: Development and Production of an Additive Component

2149700, WS 21/22, 2 SWS, Language: German, Open in study portal
Content
The lecture "Project Internship Additive Manufacturing: Development and Production of an Additive Component" combines the basics of metallic laser powder bed fusion (LPBF) with a development project in cooperation with an industrial company. The students learn the basics of the following topics in the project-related lecture:

- Influence of different process variables on the component quality of parts produced in the LPBF process
- Preparation and simulation of the LPBF process
- Production of additive metallic components
- Process monitoring and quality assurance in additive manufacturing
- Topology optimization
- CAM for subtractive rework

The topics addressed in the course will be applied practically in various workshops on the individual topics and transferred to the developmental task in self-study. Finally, the results of the elaborations are produced additively and post-processed subtractively.

Learning Outcomes:
The students ...

- are able to describe the properties and applications of the additive manufacturing processes laser powder bed fusion (LPBF) and lithography assisted ceramic manufacturing (LCM).
- are able to select the appropriate manufacturing process for a technical application.
- are able to describe and implement the creation of a product along the entire additive process chain (CAD, simulation, work preparation, CAM) from the idea to the production.
- are able to discuss the development process for components that are optimized for additive manufacturing.
- are able to perform topology optimization.
- are able to simulate the additive process, compensate for process-related distortions and determine the ideal alignment on the building platform.
- are able to create necessary support structures for the additive process and to derive a building order file.
- are able to create a CAM model for the subtractive rework process of additive parts.

Workload:
regular attendance: 12 hours
self-study: 108 hours

Organizational issues
Termine werden über Ilias bekannt gegeben.
Bei der Vorlesung handelt es sich um eine Blockveranstaltung.
Eine Anmeldung über Ilias ist erforderlich.
Dates will be announced via Ilias.
The lecture is a block event.
A registration via Ilias is required.

Literature
Skript zur Veranstaltung wird über Ilias (https://ilias.studium.kit.edu/) bereitgestellt
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)
10.379 Course: Project Management in Global Product Engineering Structures [T-MACH-105347]

**Responsible:** Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Peter Gutzmer  
Prof. Dr.-Ing. Sven Matthiesen

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102599 - Major Field: Powertrain Systems  
M-MACH-102605 - Major Field: Engineering Design  
M-MACH-102607 - Major Field: Vehicle Technology  
M-MACH-102610 - Major Field: Power Plant Technology  
M-MACH-102614 - Major Field: Mechatronics  
M-MACH-102615 - Major Field: Medical Technology  
M-MACH-102630 - Major Field: Mobile Machines  
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools  
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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<td>Each winter term</td>
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**Competence Certificate**  
oral exam (20 min)  
Aids: None

**Prerequisites**  
none
10.380 Course: Project Mikromanufacturing: Development and Manufacturing of Microsystems [T-MACH-105457]

**Responsible:** Prof. Dr.-Ing. Volker Schulze  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102613 - Major Field: Lifecycle Engineering  
M-MACH-102615 - Major Field: Medical Technology  
M-MACH-102618 - Major Field: Production Technology

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**Events**

| WT 21/22 | 2149680 | Project Micro-Manufacturing: Design and Manufacturing of a Microsystem | 3 SWS | / | Schulze |

**Competence Certificate**  
Alternative test achievement (graded):

- presentation (about 15 min) with weighting 40%
- scientific colloquium (about 15 min) with weighting 40%
- Project work (graded) with weighting 20%

**Prerequisites**  
None

Below you will find excerpts from events related to this course:

**Project Micro-Manufacturing: Design and Manufacturing of a Microsystem**  
2149680, WS 21/22, 3 SWS, Language: German, Open in study portal  
Cancelled

**Content**  
The course "Project micro manufacturing: design and manufacturing of a micro system" combines the basics of micro manufacturing with project work. The project work will be done in cooperation with an industry partner. The students learn the basics of micro milling, micro electric discharge machining, micro laser ablation, micro powder injection molding and micro quality assurance. Furthermore they get to know the CAD-CAM process chain. That is the manufacturing of a production out of a CAD model. The students develop ideas and concepts matching the given task and present the results to the industry partner. Then they create parts that are designed for manufacturability out of their concepts. Those parts are manufactured at the wbk and finally assembled to a prototype.

**Learning Outcomes:**  
The students ...

- are able to describe the micro manufacturing processes as well as their characteristics and applications.
- can choose suitable manufacturing processes for a given product.
- are able to describe the process along the CAD-CAM process chain from scratch to manufacturing.
- can explain how the development process for a micro product looks like.
- are able to describe how design for manufacturability works for micro products and where the differences to macroscopic scale are.

**Workload:**

regular attendance: 31,5 hours  
self-study: 148,5 hours
Organizational issues
Die Veranstaltung wird im Wintersemester 2021/22 nicht angeboten!

Literature
Medien:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
10.381 Course: Project Workshop: Automotive Engineering [T-MACH-102156]

**Responsible:** Dr.-Ing. Michael Frey  
Prof. Dr. Frank Gauterin  
Dr.-Ing. Martin Gießler

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102607 - Major Field: Vehicle Technology

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**Events**

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**Exams**

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Legend: 🗣 Online, 🡤 Blended (On-Site/Online), 🥁 On-Site, ❌ Cancelled

**Competence Certificate**

Oral examination

Duration: 30 up to 40 minutes

Auxiliary means: none

**Prerequisites**

none

Below you will find excerpts from events related to this course:

**Project Workshop: Automotive Engineering**

2115817, SS 2021, 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:**

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
The Skripte a. Steinle, Literature Date previous Limited Termin Semesters Begrenzte Organizational issues presentation be. At the presentation of the project results will be provided to the company management and to institute representatives. Learning Objectives: At the beginning of the project workshop 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: At the beginning of the project workshop 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 Teilnehmererzahl 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.
10.382 Course: ProVIL - Product Development in a Virtual Idea Laboratory [T-MACH-106738]

Responsible: Prof. Dr.-Ing. Albert Albers
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🚤 On-Site, ✗ Cancelled

Competence Certificate

Colloquia and presentations.

Prerequisites

None

Below you will find excerpts from events related to this course:

ProVIL - Product Development in a Virtual Idea Laboratory

Content

The course ProVIL is carried out as an innovation project with 4 phases and a reality-related task. Using state-of-the-art hardware and software, the students develop their own product concepts in a team and carry out the following activities:

- Analysis of the existing market and the environment of a product area
- Identification and analysis of customer requirements
- Modelling of customer and user benefits as product profiles
- Validation of product profiles for target customer markets
- Generation of solution ideas for the technical implementation of product profiles
- Evaluation and selection of the best ideas
- Implementation of the selected ideas in functional prototypes
- Evaluation of the functional prototypes through planning, implementation, evaluation and interpretation of appropriate experiments

Experiments

- Presentation of the prototypes in a closing event

Prerequisites

None
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**Responsible:** Dr. Johannes Eichenhofer  
**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-102596 - Compulsory Elective Subject Economics/Law

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), ⚒ On-Site, ✗ Cancelled
**10.384 Course: Python Algorithm for Vehicle Technology [T-MACH-110796]**

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<th>Stephan Rhode</th>
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**Topics Covered**

- 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

**Competence Certificate**

- Written Examination
- Duration: 90 minutes
- Prerequisites:

  none

**Below you will find excerpts from events related to this course:**

**Python Algorithms for Automotive Engineering**

2114862, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**

**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
Campus Ost, Geb. 70.04, Raum 219
Termine siehe Institutshomepage
Bitte bringen Sie Ihren Laptop mit zu den Vorlesungen!
Please bring your laptop to the lecture!

Literature

- A Whirlwind Tour of Python, Jake VanderPlas, Publisher: O'Reilly Media, Inc. Release Date: August 2016, ISBN: 9781492037859 [link](#)
- Introduction to Machine Learning with Python, Sarah Guido, Andreas C. Müller, Publisher: O'Reilly Media, Inc., Release Date: October 2016, ISBN: 9781449369880, [link](#)
10.385 Course: Quality Management [T-MACH-102107]

**Responsible:** Prof. Dr.-Ing. Gisela Lanza

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102596 - Compulsory Elective Subject Economics/Law
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102605 - Major Field: Engineering Design
- M-MACH-102618 - Major Field: Production Technology
- M-MACH-102640 - Major Field: Technical Logistics
- M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

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**Events**

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**Exams**

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Written Exam (60 min)

**Prerequisites**

none

Below you will find excerpts from events related to this course:

**Quality Management**

2149667, WS 21/22, 2 SWS, Language: German, Open in study portal

Lecture (V)

Blended (On-Site/Online)
Content
Based on the quality philosophies Total Quality Management (TQM) and Six Sigma, the lecture deals with the requirements of modern quality management. Within this context, the process concept of a modern enterprise and the process-specific fields of application of quality assurance methods are presented. The lecture covers the current state of the art in preventive and non-preventive quality management methods in addition to manufacturing metrology, statistical methods and service related quality management. The content is completed with the presentation of certification possibilities and legal quality aspects.

Main topics of the lecture:
- The term "Quality"
- Total Quality Management (TQM) and Six Sigma
- Universal methods and tools
- QM during early product stages – product denition
- QM during product development and in procurement
- QM in production – manufacturing metrology
- QM in production – statistical methods
- QM in service
- Quality management systems
- Legal aspects of QM

Learning Outcomes:
The students …
- are capable to comment on the content covered by the lecture.
- are capable of substantially quality philosophies.
- are able to apply the QM tools and methods they have learned about in the lecture to new problems from the context of the lecture.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques they have learned about in the lecture for a specific problem.

Workload:
regular attendance: 21 hours
self-study: 99 hours

Organizational issues
Start: 18.10.2021
Vorlesungstermine montags 10:00 Uhr
Übung erfolgt während der Vorlesung

Literature
Medien:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt:

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
10.386 Course: Rail System Technology [T-MACH-106424]

**Responsible:** Prof. Dr.-Ing. Marcus Geimer  
Prof. Dr.-Ing. Peter Gratzfeld  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102641 - Major Field: Rail System Technology

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Legend: ██ Online, 🚅 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Oral examination  
Duration: ca. 20 minutes  
No tools or reference materials may be used during the exam.

**Prerequisites**

none

**Below you will find excerpts from events related to this course:**

**V Rail System Technology**  
2115919, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Content**

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact  
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling  
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram  
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return  
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles  
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control  
7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

**Organizational issues**

Die Vorlesung "Bahnsystemtechnik" findet im SS 2021 als asynchrone Online-Veranstaltung statt.

**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 21/22, 2 SWS, Language: German, [Open in study portal](#)
Content

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
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7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

Literature

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.
A bibliography is available for download (Ilias-platform).
10.387 Course: Rail Vehicle Technology [T-MACH-105353]

- **Responsible:** Prof. Dr.-Ing. Marcus Geimer
  Prof. Dr.-Ing. Peter Gratzfeld
- **Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102641 - Major Field: Rail System Technology

**Events**

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**Competition Certificate**

- **Oral examination**
  - Duration: ca. 20 minutes
  - No tools or reference materials may be used during the exam.

**Prerequisites**

- none

**Below you will find excerpts from events related to this course:**

### Rail Vehicle Technology

- **2115996, SS 2021, 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, 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

**Organizational issues**

Die Vorlesung "Schienenfahrzeugtechnik" findet im SS 2021 als asynchrone Online-Veranstaltung statt.

**Literature**

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

A bibliography is available for download (Ilias-platform).
Rail Vehicle Technology
2115996, WS 21/22, 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: principles, electric drives (main components, asynchronous traction motor, inverter, with DC supply, with AC supply, without line supply, multisystem vehicles, dual mode vehicles, hybrid vehicles), non-electric drives
5. Brakes: basics, principles (wheel brakes, rail brakes, blending), brake control (requirements and operation modes, pneumatic brake, electropneumatic brake, emergency brake, parking brake)
6. Train control management system: definition of TCMS, bus systems, components, network architectures, examples, future trends

Literature
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.
A bibliography is available for download (Ilias-platform).
10.388 Course: Railways in the Transportation Market [T-MACH-105540]

**Responsible:** Prof. Dr.-Ing. Marcus Geimer  
Prof. Dr.-Ing. Peter Gratzfeld

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102641 - Major Field: Rail System Technology

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**Events**

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**Exams**

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**Legend:**  
🖥 Online,  
🧩 Blended (On-Site/Online),  
🗣 On-Site,  
🗙 Cancelled

**Competence Certificate**

Oral examination  
Duration: ca. 20 minutes

No tools or reference materials may be used during the exam.

**Prerequisites**

none

**Below you will find excerpts from events related to this course:**

**Railways in the Transportation Market**

2114914, SS 2021, 2 SWS, Language: German, [Open in study portal]

**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 10. / 11. / 12.06.2021 von 09:00 bis 16:00 Uhr online statt. Die Prüfung findet am 05.07.2021 in Präsenz statt.
Näheres siehe Homepage http://www.fast.kit.edu/bst/929.php

Literature
keine
Course: Reactor Safety I: Fundamentals [T-MACH-105405]

Responsible: Dr. Victor Hugo Sanchez-Espinoza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102608 - Major Field: Nuclear Energy

Type: Oral examination
Credits: 4
Grading scale: Grade to a third
Recurrence: Each summer term
Version: 1

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WT 21/22 | 76-T-MACH-105405 | Reactor Safety I: Fundamentals | Lecture | 2 SWS | Online | Online | 1 |

Legend: ⚡ Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate
oral exam about 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

Reactor Safety I: Fundamentals
2189465, SS 2021, 2 SWS, Language: German/English, Open in study portal

Lecture (V)
Online
Content
This lecture will be given in English, if required in German

The lecture discuss the fundamental principles and concepts of reactor safety including the methodologies for safety assessment and major accidents.

In the lecture, the fundamental principles and concepts of reactor safety are discussed. They facilitate the assessment of the safety status of nuclear power plants and the interpretation of incidents or accidents as such as Chernobyl or Fukushima. Starting with the explanations of the technical safety features of reactor systems, the safety concepts of different reactor types are discussed. The initiation and progression of incidents/accidents as well as the methods for the safety evaluation are also treated in the lecture. Discussing the Fukushima accident, the radiological risk from nuclear power plants together with the counter measures to stop severe accident and to limit the consequences will be explained. Finally, new development to increase the safety or reactors of Generation III and IV will be presented.

Lecture Content:

- National and international nuclear regulations
- Fundamental principles of reactor safety
- Implementation of safety principles in nuclear power plants of generation 2
- Methods for safety analysis and safety assessment
- Key physical phenomena during severe accidents determining radiological impact
- How to analyse reactor accidents with numerical simulation tools
- Discussion severe accidents e.g. the Fukushima accident

Lernziele

Lecture Content:

- National and international nuclear regulations
- Fundamental principles of reactor safety
- Implementation of safety principles in nuclear power plants of generation 2
- Safety analysis and methods for safety assessment
- Nuclear events and accidents and its evaluation methods
- Discussion severe accidents

Knowledge in energy technology, nuclear power plants, reactor physics, thermal hydraulic of nuclear reactors is welcomed.

regular attendance: 30 h
self-study: 60 h

Zielgruppe: Students of Mechanical Engineering,
oral examination, duration approximately 30 minutes

Organizational issues

Mündliche Prüfung (Oral examination)
Anmeldung im ILIAS (Registration through ILIAS)

Literature

- A. Ziegler, Lehrbuch der Reaktortechnik Band 1 und 2, Springer Verlag, 1986
- D. Smidt, Reaktorsicherheitstechnik. Springer-Verlag Berlin Heidelberg New York. 1979
- D. Smidt, Reaktortechnik, Band 2, Verlag G. Braun, Karlsruhe, 1976

**Responsible:** Dr. Viatcheslav Bykov  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering  
M-MACH-102635 - Major Field: Engineering Thermodynamics

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<td>Reduction methods for the modeling and the simulation of combustion processes</td>
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**Legend:** Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**  
Oral exam, approx. 20 min

**Prerequisites**  
none

**Below you will find excerpts from events related to this course:**

**Reduction methods for the modeling and the simulation of combustion processes**

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**Content**

The course will introduce the principles of model reduction of chemical kinetic models of combustion processes. The basic mathematical concepts and methods of analysis of chemical reaction mechanisms will be outlined in the context of model reduction. The detailed implementation scheme of model reduction will be introduced. The course will cover simplified and idealized models of combustion (e.g. auto-ignition, explosion, deflagration etc.), which will be analyzed and reduced. The main analytical methods and numerical tools will be presented, evaluated and illustrated by using these simple examples.

**Organizational issues**

Termin: Mi, 14:00-15:30. Für Änderungen siehe Aushang im ITT-Schaukasten und auf der Internetseite des Instituts.

**Literature**

## 10.391 Course: Reliability Engineering 1 [T-MACH-107447]

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<tr>
<th>Responsible</th>
<th>Dr.-Ing. Alexei Konnov</th>
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<td>M-MACH-102624 - Major Field: Information Technology</td>
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<td>M-MACH-102627 - Major Field: Energy Converting Engines</td>
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<td>Recurrence</td>
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**Competence Certificate**
written exam

**Prerequisites**
none
10 COURSES


Responsible: PD Dr. Patrick Jochem
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104323 - Major Field: Innovation and Entrepreneurship

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Events

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Exams

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Competence Certificate
The assessment consists of a written exam (60 minutes, in English, answers are possible in German or English) (following §4(2) of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date. Depending on the respective pandemic situation, the exam may be offered as an open book exam (alternative exam assessment, following §4(2), 3 of the examination regulation).

Prerequisites
None.

Below you will find excerpts from events related to this course:

Renewable Energy – Resources, Technologies and Economics
2581012, WS 21/22, 2 SWS, Language: English, Open in study portal

Lecture (V)

Content
1. General introduction: Motivation, Global situation
2. Basics of renewable energies: Energy balance of the earth, potential definition
3. Hydro
4. Wind
5. Solar
6. Biomass
7. Geothermal
8. Other renewable energies
9. Promotion of renewable energies
10. Interactions in systemic context
11. Excursion to the "Energieberg" in Mühlburg

Learning Goals:
The student

- understands the motivation and the global context of renewable energy resources,
- gains detailed knowledge about the different renewable resources and technologies as well as their potentials,
- understands the systemic context and interactions resulting from the increased share of renewable power generation,
- understands the important economic aspects of renewable energies, including electricity generation costs, political promotion and marketing of renewable electricity,
- is able to characterize and where required calculate these technologies.

Organizational issues
Blockveranstaltung, freitags 14:00-17:00 Uhr, 29.10., 12.11., 26.11., 10.12., 14.01., 28.01., 11.02.
Literature
Weiterführende Literatur:

10.393 Course: Robotics I - Introduction to Robotics [T-INFO-108014]

**Responsible:** Prof. Dr.-Ing. Tamim Asfour  
**Organisation:** KIT Department of Informatics  
**Part of:**  
M-MACH-102598 - Major Field: Advanced Mechatronics  
M-MACH-102609 - Major Field: Cognitive Technical Systems  
M-MACH-102615 - Major Field: Medical Technology  
M-MACH-102633 - Major Field: Robotics  
M-MACH-102647 - Major Field: Microactuators and Microsensors

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
**Course: Robotics II: Humanoid Robotics [T-INFO-105723]**

**Responsible:** Prof. Dr.-Ing. Tamim Asfour  
**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-102615 - Major Field: Medical Technology  
M-MACH-102633 - Major Field: Robotics

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**Legend:**  
- Online  
- Blended (On-Site/Online)  
- On-Site  
- Cancelled

**Below you will find excerpts from events related to this course:**

**Robotics II: Humanoid Robotics**  
2400074, SS 2021, 2 SWS, Language: German/English, Open in study portal

**Content**

The lecture presents current work in the field of humanoid robotics that deals with the implementation of complex sensorimotor and cognitive abilities. In the individual topics different methods and algorithms, their advantages and disadvantages, as well as the current state of research are discussed.

The topics addressed are: biomechanical models of the human body, biologically inspired and data-driven methods of grasping, active perception, imitation learning and programming by demonstration as well as semantic representations of sensorimotor experience.

**Learning Objectives:**

The students have an overview of current research topics in autonomous learning robot systems using the example of humanoid robotics. They are able to classify and evaluate current developments in the field of cognitive humanoid robotics.

The students know the essential problems of humanoid robotics and are able to develop solutions on the basis of existing research.

**Organizational issues**

Die Erfolgskontrolle erfolgt in Form einer schriftlichen Prüfung im Umfang von i.d.R. 60 Minuten nach § 4 Abs. 2 Nr. 1 SPO.  
Arbeitsaufwand: 90 h  
Voraussetzungen: Der Besuch der Vorlesungen *Robotik I – Einführung in die Robotik* und *Mechano-Informatik in der Robotik* wird vorausgesetzt  
Zielgruppe: Modul für Master Maschinenbau, Mechatronik und Informationstechnik, Elektrotechnik und Informationstechnik

**Literature**

**Weiterführende Literatur**

Wissenschaftliche Veröffentlichungen zum Thema, werden auf der VL-Website bereitgestellt.
Below you will find excerpts from events related to this course:

**Content**

The lecture supplements the lecture Robotics I with a broad overview of sensors used in robotics. The lecture focuses on visual perception, object recognition, simultaneous localization and mapping (SLAM) and semantic scene interpretation. The lecture is divided into two parts:

In the first part a comprehensive overview of current sensor technologies is given. A basic distinction is made between sensors for the perception of the environment (exteroceptive) and sensors for the perception of the internal state (proprioceptive).

The second part of the lecture concentrates on the use of exteroceptive sensors in robotics. The topics covered include tactile exploration and visual data processing, including advanced topics such as feature extraction, object localization, simultaneous localization and mapping (SLAM) and semantic scene interpretation.

**Learning Objectives:**

Students know the main sensor principles used in robotics and understand the data flow from physical measurement through digitization to the use of the recorded data for feature extraction, state estimation and environmental modeling.

Students are able to propose and justify suitable sensor concepts for common tasks in robotics.

**Organizational issues**

Die Erfolgskontrolle erfolgt in Form einer schriftlichen Prüfung im Umfang von i.d.R. 60 Minuten nach § 4 Abs. 2 Nr. 1 SPO.

Modul für Master Maschinenbau, Mechatronik und Informationstechnik, Elektrotechnik und Informationstechnik

Voraussetzungen: Der Besuch der Vorlesung Robotik I – Einführung in die Robotik wird vorausgesetzt

Zielgruppe: Die Vorlesung richtet sich an Studierende der Informatik, der Elektrotechnik und des Maschinenbaus sowie an alle Interessenten an der Robotik.

Arbeitsaufwand: 90 h

**Literature**

Eine Foliensammlung wird im Laufe der Vorlesung angeboten.

Begleitende Literatur wird zu den einzelnen Themen in der Vorlesung bekannt gegeben.
10.396 Course: Safety Engineering [T-MACH-105171]

Responsible: Hans-Peter Kany
Organisation: KIT Department of Mechanical Engineering

Part of:  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102600 - Major Field: Man - Technology - Organisation
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102613 - Major Field: Lifecycle Engineering
M-MACH-102629 - Major Field: Logistics and Material Flow Theory
M-MACH-102636 - Major Field: Thermal Turbomachines
M-MACH-102640 - Major Field: Technical Logistics

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Events

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Competence Certificate

The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites

none

Below you will find excerpts from events related to this course:

Safety Engineering

2117061, WS 21/22, 2 SWS, Language: German, Open in study portal

Content

Media
Presentations

Learning content

The course provides basic knowledge of safety engineering. In particular the basics of health at the working place, job safety in Germany, national and European safety rules and the basics of safe machine design are covered. The implementation of these aspects will be illustrated by examples of material handling and storage technology. This course focuses on: basics of safety at work, safety regulations, basic safety principles of machine design, protection devices, system security with risk analysis, electronics in safety engineering, safety engineering for storage and material handling technique, electrical dangers and ergonomics. So, mainly, the technical measures of risk reduction in specific technical circumstances are covered.

Learning goals

The students are able to:

- Name and describe relevant safety concepts of safety engineering,
- Discuss basics of health at work and labour protection in Germany,
- Evaluate the basics for the safe methods of design of machinery with the national and European safety regulations and
- Realize these objectives by using examples in the field of storage and material handling systems.

Recommendations

None

Workload
Regular attendance: 21 hours
Self-study: 99 hours

Organizational issues
Literature
Defren/Wickert: Sicherheit für den Maschinen- und Anlagenbau, Druckerei und Verlag: H. von Ameln, Ratingen
10.397 Course: Scaling in Fluid Dynamics [T-MACH-105400]

Responsible: apl. Prof. Dr. Leo Bühler
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102634 - Major Field: Fluid Mechanic

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<th>2 SWS</th>
<th>Lecture / Online</th>
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Exams

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Legend: 🤖 Online, 💻 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

Competence Certificate

Oral exam
Duration: 20-30 minutes
No auxiliary means

Prerequisites

none

Recommendation

Fluid Mechanics (T-MACH-105207)

Below you will find excerpts from events related to this course:

Scaling in fluid dynamics
2154044, SS 2021, 2 SWS, Language: German, Open in study portal

Content

- Introduction
- Similarity rules (examples)
- Dimensional analysis (Pi-theorem)
- Scaling in differential equations
- Scaling in boundary layers
- Self-similar solutions
- Scaling in turbulent shear layers
- Rotating flows
- Magnetohydrodynamic flows

Educational objective: The student can extract non-dimensional number from the characteristic properties of flows. From the insights on scaling laws, the students are qualified to identify the influencing quantities from generic experiments and transfer these to real applications. The students can simplify the governing equations of fluid mechanic appropriately and can interpret the achieved results as a basis for efficient solution strategies.

Organizational issues

per E-Mail an leo.buehler@kit.edu

Literature

G. I. Barenblatt, 1979, Similarity, Self-Similarity, and Intermediate Asymptotics, Plenum Publishing Corporation (Consultants Bureau)
J. Zierep, 1982, Ähnlichkeitsgesetze und Modellregeln der Strömungsmechanik, Braun
J. H. Spurk, 1992, Dimensionsanalyse in der Strömungslehre, Springer
10.398 Course: Scientific Computing for Engineers [T-MACH-100532]

**Responsible:** Prof. Dr. Peter Gumbsch  
Dr. Daniel Weygand  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering  
M-MACH-102646 - Major Field: Applied Mechanics  
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering  
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering  
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

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<td>Scientific computing for Engineers</td>
<td>2</td>
<td>Online</td>
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<td>2181739</td>
<td>Exercises for Scientific Computing for Engineers</td>
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**Exams**

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<td>Scientific Computing for Engineers</td>
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</tr>
</tbody>
</table>

**Legend:**  
🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**
Written exam (90 minutes)

**Prerequisites**
The brick can not be combined with the brick "Application of advanced programming languages in mechanical engineering" (T-MACH-105390).

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-105390 - Application of Advanced Programming Languages in Mechanical Engineering must not have been started.

Below you will find excerpts from events related to this course:

**Scientific computing for Engineers**
2181738, WS 21/22, 2 SWS, Language: German, Open in study portal
Content
1. Introduction: why scientific computing
2. computer architectures
3. Introduction to Unix/Linux
4. Foundations of C++
   * program organization
   * data types, operator, control structures
   * dynamic memory allocation
   * functions
   * class
   * OpenMP parallelization
5. numeric /algorithms
   * finite differences
   * MD simulations: 2nd order differential equations
   * algorithms for particle simulations
   * solvers for linear systems of eqns.

The student can
- apply the programming language C++ for scientific computing in the field of materials science
- adapt programs for use on parallel platforms
- choose suitable numerical methods for the solution of differential equations.

The lecture can not be combined with the lecture "Application of advanced programming languages in mechanical engineering" (2182735).

regular attendance: 22.5 hours
Lab: 22.5 hours (optional)
self-study: 75 hours
written exam 90 minutes

Organizational issues
nach aktuellem Stand: unklar ob online/hybrid/vor Ort....

Literature
1. C++: Einführung und professionelle Programmierung; U. Breymann, Hanser Verlag München
2. C++ and object-oriented numeric computing for Scientists and Engineers, Daoqui Yang, Springer Verlag.
3. The C++ Programming Language, Bjarne Stroustrup, Addison-Wesley
4. Die C++ Standardbibliothek, S. Kuhlins und M. Schader, Springer Verlag

Numerik:
1. Numerical recipes in C++ / C / Fortran (90), Cambridge University Press
2. Numerische Mathematik, H.R. Schwarz, Teubner Stuttgart
3. Numerische Simulation in der Moleküldynamik, Griebel, Knapek, Zumbusch, Caglar, Springer Verlag

Exercises for Scientific Computing for Engineers
2181739, WS 21/22, 2 SWS, Language: German, Open in study portal

Content
Exercises for the different topics of the lecture "Scientific computing for Engineers" (2181738)
regular attendance: 22.5 hours

Organizational issues
Veranstaltungsort (RZ Pool Raum) wird in Vorlesung bekannt gegeben

Literature
Skript zur Vorlesung "Wissenschaftliches Programmieren für Ingenieure" (2181738)
10.399 Course: Selected Applications of Technical Logistics [T-MACH-102160]

Responsible: Viktor Milushev
Dr.-Ing. Martin Mittwollen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102640 - Major Field: Technical Logistics

Type: Oral examination
Credits: 4
Grading scale: Grade to a third
Recurrence: Each summer term
Version: 1

Events

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Exams

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate
The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

Recommendation
Knowledge out of Basics of Technical Logistics I (T-MACH-109919) / Elements and Systems of Technical Logistics (T-MACH-102159) preconditioned.

Below you will find excerpts from events related to this course:

Selected Applications of Technical Logistics
2118087, SS 2021, 3 SWS, Language: German, Open in study portal

Content
- design and dimension of machines from intralogistics
- static and dynamic behaviour
- operation properties and specifics
- Inside practical lectures: sample applications and calculations in addition to the lectures

Details according schedule will be published

Organizational issues
Die Erfolgskontrolle erfolgt in Form einer mündlichen (20min.) Prüfung (nach §4 (2), 2 SPO). Die Prüfung wird in jedem Semester angeboten und kann zu jedem ordentlichen Prüfungstermin wiederholt werden.

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.

Es werden inhaltliche Kenntnisse aus der Veranstaltung „Grundlagen der Technischen Logistik-I“ (LV 2117095) vorausgesetzt

Knowledge out of Basics of Technical Logistics-I preconditioned

Literature
Empfehlungen in der Vorlesung
10.400 Course: Selected Applications of Technical Logistics - Project [T-MACH-108945]

**Responsible:** Viktor Milushev  
Dr.-Ing. Martin Mittwollen

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102640 - Major Field: Technical Logistics

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**Events**

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**Exams**

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<td>Selected Applications of Technical Logistics - Project</td>
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</table>

Legend: 🖥 Online, ☝ Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

presentation of performed project and defense (30min) according to §4 (2), No. 3 of the examination regulation

**Prerequisites**

T-MACH-102160 (selected applications of technical logistics) must have been started

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-102160 - Selected Applications of Technical Logistics must have been started.

**Recommendation**

Knowledge out of Basics of Technical Logistics I (T-MACH-109919) / Elements and Systems of Technical Logistics (T-MACH-102159) preconditioned.

Below you will find excerpts from events related to this course:

**Selected Applications of Technical Logistics - Project**

2118088, SS 2021, 1 SWS, Language: German, Open in study portal

**Organizational issues**

Ort und Zeit: siehe ILIAS / Homepage / Infos in der Veranstaltung

**Literature**

Empfehlungen in der Vorlesung
**10.401 Course: Selected Chapters of the Combustion Fundamentals [T-MACH-105428]**

**Responsible:** Prof. Dr. Ulrich Maas  
**Organisation:** KIT Department of Mechanical Engineering  

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102635 - Major Field: Engineering Thermodynamics

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**Events**

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**Exams**

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**Competence Certificate**  
Oral exam, approx. 20 min

**Prerequisites**  
none

*Below you will find excerpts from events related to this course:*

### Content

Depending on the lecture: Fundamentals of chemical kinetics, of statistical modeling of turbulent flames or of droplet and spray combustion.

### Organizational issues

Blockveranstaltung. Termine siehe Schaukasten und Internetseite des Instituts.

### Literature

Vorlesungsunterlagen


### Content

Depending on the lecture: Fundamentals of chemical kinetics, of statistical modeling of turbulent flames or of droplet and spray combustion.

### Organizational issues

Termine und Raum: siehe Aushang und Internetseite des Instituts.

### Literature

Vorlesungsunterlagen

Course: Selected Problems of Applied Reactor Physics and Exercises [T-MACH-105462]

Responsible: apl. Prof. Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology

Type: Oral examination
Credits: 4
Grading scale: Grade to a third
Recurrence: Each summer term
Version: 1

Events

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<td>Dagan, Metz</td>
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Exams

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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
oral exam, approx. 1/2 hour

Prerequisites
none

Below you will find excerpts from events related to this course:

Selected Problems of Applied Reactor Physics and Exercises
2190411, SS 2021, 2 SWS, Language: German/English, Open in study portal

Content

- Nuclear energy and forces
- Radioactive decay
- Nuclear processes
- Fission and the importance of delayed neutrons
- Basics of nuclear cross sections
- Principles of chain reaction
- Static theory of mono energetic reactors
- Introduction to reactor kinetic
- student laboratory

The students

- have solid understanding of the basic reactor physics
- are able to estimate processes of growth and decay of radionuclides; out of it, they can perform dose calculation and introduce their biological hazards
- can calculate the relationship of basic parameters which are needed for a stable reactor operation
- understand important dynamical processes of nuclear reactors.

Regular attendance: 26 h
self study 94 h
oral exam about 30 min.

Literature
K. Wirtz Grundlagen der Reaktortechnik Teil I, II, Technische Hochschule Karlsruhe 1966
J. Duderstadt and L. Hamilton, Nuclear reactor Analysis, J. Wiley $ Sons, Inc. 1975 (in English)
10.403 Course: Self-Booking-MSc-HOC-SPZ-ZAK-Graded [T-MACH-111687]

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102824 - Key Competences

### Competence Certificate
Completed coursework

### Prerequisites
None

### Self service assignment of supplementary studies
This course can be used for self service assignment of grade acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaften und Studium Generale

### Annotation
Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".
10.404 Course: Self-Booking-MSc-HOC-SPZ-ZAK-Non-Graded [T-MACH-111686]

Responsibility: Prof. Dr.-Ing. Martin Heilmmaier
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102824 - Key Competences

Competence Certificate
Completed coursework

Prerequisites
None

Self service assignment of supplementary studies
This course can be used for self service assignment of grade acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

Annotation
Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named “self-assignment” in your study schedule and second, assign an IQ-achievement via the tab “IQ achievements”.

Type: Completed coursework
Credits: 2
Grading scale: pass/fail
Recurrence: Each term
Version: 1
10.405 Course: Seminar Data-Mining in Production [T-MACH-108737]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102618 - Major Field: Production Technology

Type: Examination of another type
Credits: 3
Grading scale: Grade to a third
Recurrence: Each term
Version: 1

Events

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<th>Theme</th>
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<td>Lanza</td>
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<td>Seminar /</td>
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Exams

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</table>

Competence Certificate
alternative test achievement (graded):
- written elaboration (workload of at least 80 h)
- oral presentation (approx. 30 min)

Prerequisites
none

Annotation
The number of students is limited to twelve. Dates and deadlines for the seminar will be announced at https://www.wbk.kit.edu/studium-und-lehre.php.

Below you will find excerpts from events related to this course:

Seminar Data Mining in Production
2151643, SS 2021, 2 SWS, Language: German, Open in study portal

Content
In the age of Industry 4.0, large amounts of production data are generated by the global production networks and value chains. Their analysis enables valuable conclusions about production and lead to an increasing process efficiency. The aim of the seminar is to get to know production data analysis as an important component of future industrial projects. The students get to know the data mining tool KNIME and use it for analyses. A specific industrial use case with real production data enables practical work and offers direct references to industrial applications. The participants learn selected methods of data mining and apply them to the production data. The work within the seminar takes place in small groups on the computer. Subsequently, presentations on specific data mining methods have to be prepared.

Learning Outcomes:
The students ...
- can name, describe and distinguish between different methods, procedures and techniques of production data analysis.
- can perform basic data analyses with the data mining tool KNIME.
- can analyze and evaluate the results of data analyses in the production environment.
- are able to derive suitable recommendations for action.
- are able to explain and apply the CRISP-DM model.

Workload:
regular attendance: 10 hours
self-study: 80 hours
Organizational issues

The number of students is limited to twelve. Dates and deadlines for the seminar will be announced at https://www.wbk.kit.edu/studium-und-lehre.php.

Literature
Medien: KNIME Analytics Platform

Media: KNIME Analytics Platform

Seminar Data Mining in Production
2151643, WS 21/22, 2 SWS, Language: German, Open in study portal

Seminar (S)  Blended (On-Site/Online)

Content
In the age of Industry 4.0, large amounts of production data are generated by the global production networks and value chains. Their analysis enables valuable conclusions about production and lead to an increasing process efficiency. The aim of the seminar is to get to know production data analysis as an important component of future industrial projects. The students get to know the data mining tool KNIME and use it for analyses. A specific industrial use case with real production data enables practical work and offers direct references to industrial applications. The participants learn selected methods of data mining and apply them to the production data. The work within the seminar takes place in small groups on the computer. Subsequently, presentations on specific data mining methods have to be prepared.

Learning Outcomes:
The students ...

• can name, describe and distinguish between different methods, procedures and techniques of production data analysis.
• can perform basic data analyses with the data mining tool KNIME.
• can analyze and evaluate the results of data analyses in the production environment.
• are able to derive suitable recommendations for action.
• are able to explain and apply the CRISP-DM model.

Workload:
regular attendance: 10 hours
self-study: 80 hours

Organizational issues

The number of students is limited to twelve. Dates and deadlines for the seminar will be announced at https://www.wbk.kit.edu/studium-und-lehre.php.

Literature
Medien: KNIME Analytics Platform

Media: KNIME Analytics Platform
**10.406 Course: Seminar for Rail System Technology [T-MACH-108692]**

**Responsible:** Prof. Dr.-Ing. Marcus Geimer  
Prof. Dr.-Ing. Peter Gratzfeld

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102641 - Major Field: Rail System Technology

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🌐 On-Site, 🗑 Canceled

**Competence Certificate**

Examination: Writing a Seminararbeit, final presentation

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

**Seminar for Rail System Technology**

2115009, SS 2021, 1 SWS, Language: German, [Open in study portal]

**Content**

1. **Railway System:** railway as a 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. **System structure of railway vehicles:** structure and major systems of rail vehicles  
4. **Scientific working:** structuring and writing of scientific papers, literature research, scheduling (milestones), self-management, presentation skills, using the software Citavi for literature and knowledge management, working with templates in Word, giving and taking feedback  
5. The learnt knowledge regarding scientific writing is used to elaborate a Seminararbeit. To this the students create a presentation, train and reflect it and finally present it to an auditorium.

**Learning targets:**

- The students become aware of the fundamental relations and interdependencies between rail vehicles, infrastructure and operation in a rail system.  
- They overview the technical components of a rail system, in particular rail vehicle technology.  
- They are able to use the essential elements of scientific work and present their results in written form and verbal presentation.

**Organizational issues**

Teilnehmerzahl ist auf 10 begrenzt. Die Prüfung besteht aus einer schriftlichen Ausarbeitung (Seminararbeit) und einem Vortrag über die Ausarbeitung. Weitere Infos siehe Institutshomepage.  
Max. 10 participants. Examination: Writing a Seminararbeit, final presentation. Please check the homepage for further information.
**Content**

- Railway system: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact, history, challenges and future developments in the context of mega trends
- Operation: Transportation, public/regional/long-distance transport, freight service, scheduling
- System structure of railway vehicles: Tasks and classification, main systems
- Project management: definitions, project management, main and side processes, transfer to practice
- Scientific working: structuring and writing of scientific papers, literature research, scheduling (mile stones), self-management, presentation skills, using the software Citavi for literature and knowledge management, working with templates in Word, giving and taking feedback
- The learnt knowledge regarding scientific writing is used to elaborate a Seminararbeit. To this the students create a presentation, train and reflect it and finally present it to an auditorium.

**Organizational issues**

Teilnehmerzahl ist auf 10 begrenzt. Die Prüfung besteht aus einer schriftlichen Ausarbeitung (Seminararbeit) und einem Vortrag über die Ausarbeitung. Weitere Infos siehe Institutshomepage.
Max. 10 participants. Examination: Writing a Seminararbeit, final presentation. Please check the homepage for further information.

**Literature**

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

A bibliography is available for download (Ilias-platform).
### T 10.407 Course: Sensors [T-ETIT-101911]

**Responsible:** Dr. Wolfgang Menesklou  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🔘 On-Site, ✗ Cancelled
10.408 Course: Signals and Systems [T-ETIT-109313]

**Responsible:** Prof. Dr.-Ing. Michael Heizmann

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:**
- M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics

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**Prerequisites**

none

Legend: ▶ Online, © Blended (On-Site/Online), ☎ On-Site, ⏳ Cancelled
### Course: Simulation of Coupled Systems [T-MACH-105172]

**Responsible:** Prof. Dr.-Ing. Marcus Geimer  
Yusheng Xiang  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102630 - Major Field: Mobile Machines  
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗓 On-Site, ✗ Cancelled

**Competence Certificate**

The assessment consists of an oral exam (20 min) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at very 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.

**Prerequisites**

Required for the participation in the examination is the preparation of a report during the semester. The partial service with the code T-MACH-108888 must have been passed.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-108888 - Simulation of Coupled Systems - Advance must have been passed.

**Recommendation**

- Knowledge of ProE (ideally in actual version)  
- Basic knowledge of Matlab/Simulink  
- Basic knowledge of dynamics of machines  
- Basic knowledge of hydraulics
Annotation
After completion of course, students are able to:

- build a coupled simulation
- parametrize models
- perform simulations
- conduct troubleshooting
- check results for plausibility

The number of participants is limited.

Content:

- Basics of multi-body and hydraulic simulation programs
- Possibilities of coupled simulations
- Modelling and Simulation of Mobile Machines using a wheel loader
- Documentation of the result in a short report

Literature:
Software guide books (PDFs)
Information about wheel-type loader specifications

Below you will find excerpts from events related to this course:

Simulation of Coupled Systems
2114095, SS 2021, 2 SWS, Language: German, Open in study portal

Content

- Knowledge of the basics of multi-body and hydraulic simulation programs
- Possibilities of coupled simulations
- Development of a simulation model by using the example of a wheel loader
- Documentation of the result in a short report

It is recommended to have:

- Knowledge of ProE (ideally in current version)
- Basic knowledge of Matlab/Simulink
- Basic knowledge of dynamics of machines
- Basic knowledge of hydraulics

- regular attendance: 21 hours
- total self-study: 92 hours

Literature
Weiterführende Literatur:

- Diverse Handbücher zu den Softwaretools in PDF-Form
- Informationen zum verwendeten Radlader
10.410 Course: Simulation of Coupled Systems - Advance [T-MACH-108888]

**Responsible:** Prof. Dr.-Ing. Marcus Geimer  
Yusheng Xiang

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102630 - Major Field: Mobile Machines  
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics

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**Competence Certificate**

Preparation of semester report

**Prerequisites**

none
10.411 Course: Simulation of Optical Systems [T-MACH-105990]

**Responsible:** PD Dr.-Ing. Ingo Sieber

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102601 - Major Field: Automation Technology
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102615 - Major Field: Medical Technology
- M-MACH-102633 - Major Field: Robotics

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**Legend:**
- 🖥 Online
- 🧩 Blended (On-Site/Online)
- 🗣 On-Site
- ✗ Cancelled

**Competence Certificate**
oral exam (Duration: appr. 30min)

**Prerequisites**
none

Below you will find excerpts from events related to this course:

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<td>Lecture (V)</td>
<td>On-Site</td>
<td>German</td>
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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
10 COURSES  Course: Simulation of the process chain of continuously fiber reinforced composite structure [T-MACH-105971]

**10.412 Course: Simulation of the process chain of continuously fiber reinforced composite structure [T-MACH-105971]**

| Responsible: | Dr.-Ing. Luise Kärger |
| Organisation: | KIT Department of Mechanical Engineering |

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
- M-MACH-102613 - Major Field: Lifecycle Engineering
- M-MACH-102628 - Major Field: Lightweight Construction
- M-MACH-102632 - Major Field: Polymer Engineering
- M-MACH-102646 - Major Field: Applied Mechanics

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**Events**

| ST 2021 | 2114107 | Simulation der Prozesskette kontinuierlich verstärkter Faserverbundbauteile | 2 SWS | Lecture / Practice ( / 🧩) | Kärger |

**Exams**

| ST 2021 | 76-T-MACH-105971 | Simulation of the process chain of continuously fiber reinforced composite structure | Kärger |

**Competence Certificate**

oral exam, 20 minutes

**Prerequisites**

none
**10.413 Course: Simulator Exercises Combined Cycle Power Plants [T-MACH-105445]**

**Responsible:** Hon.-Prof. Dr. Thomas Schulenberg  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102610 - Major Field: Power Plant Technology  
- M-MACH-102636 - Major Field: Thermal Turbomachines

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<th>Practical course / Schulenberg</th>
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**Competence Certificate**  
oral exam (ca. 15 min)

**Prerequisites**  
none

**Recommendation**  
Participation at LV-No. 2170490 "Combined Cycle Power Plants" (T-MACH-105444) is recommended.

**Below you will find excerpts from events related to this course:**

**Simulator Exercises Combined Cycle Power Plants**  
2170491, SS 2021, 2 SWS, Language: English, Open in study portal  
Practical course (P) On-Site

**Content**  
The training objective of the course is the qualification for a research-related professional activity in power plant engineering. On the basis of the learned fundamentals in thermodynamics, in instrumentation and control engineering, as well as on the basis of the acquired knowledge of design of combined cycle plants, the participants can operate a real combined cycle power plant. This application creates a deeper understanding of the dynamic processes of the power plant, the specific importance of the plant components and the limits of the load capacity of the components. Participants can optimize normal operation and analyze incidents. They can work self-organized and reflexive. They have communicative and organizational skills in teamwork, even under major technical challenges.

Start-up of the power plant from scratch; load changes and shut down; dynamic response of the power plant in case of malfunctions and of sudden load changes; manual operation of selected components.

**Literature**  
Vorlesungsskript und weitere Unterlagen der Vorlesung Gas- und Dampfkraftwerke.  
Slides and other documents of the lecture Combined Cycle Power Plants.
10.414 Course: Smoothed Particle Hydrodynamics (SPH) in Computational Fluid Dynamics [T-MACH-111396]

**Responsible:** Dr.-Ing. Rainer Koch

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102610 - Major Field: Power Plant Technology
- M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology
- M-MACH-102636 - Major Field: Thermal Turbomachines

**Type**
- Completed coursework

**Credits**
- 4

**Grading scale**
- pass/fail

**Recurrence**
- Each winter term

**Version**
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### Events

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<th>Grading scale</th>
<th>Recurrence</th>
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<td>WT 21/22</td>
<td>3 SWS</td>
<td>Smoothed Particle Hydrodynamics (SPH) in computational fluid dynamics</td>
<td>pass/fail</td>
<td>Each winter term</td>
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**Exams**

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<tr>
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<td>Smoothed Particle Hydrodynamics (SPH) in computational fluid dynamics</td>
<td>pass/fail</td>
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**Legend:**
- 🖥 Online,
- 🧩 Blended (On-Site/Online),
- 🗣 On-Site,
- 🗑 Cancelled

**Competence Certificate**
Successfull solution of tasks

**Prerequisites**
- none

**Recommendation**
- Prior knowledge of computational fluid dynamics, SPH method and LINUX.
10 COURSES

Course: Solar Thermal Energy Systems [T-MACH-106493]


Responsible: apl. Prof. Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102623 - Major Field: Fundamentals of Energy Technology

<table>
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Events

WT 21/22 2189400 Solar Thermal Energy Systems 2 SWS Lecture / On-Site Dagan

Exams

ST 2021 76-T-MACH-106493 Solar Thermal Energy Systems Dagan

WT 21/22 76-T-MACH-106493 Solar Thermal Energy Systems Dagan

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Recommendation

Literature


Below you will find excerpts from events related to this course:

Solar Thermal Energy Systems
2189400, WS 21/22, 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 Veranstaltung wird nur online gehalten, falls durch Corona Einschränkungen vorgegeben werden.

Literature


Responsible: Dr. Peter Franke
Prof. Dr. Hans Jürgen Seifert

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering

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Events

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<td>WT 21/22</td>
<td>2193003</td>
<td>Solid State Reactions and Kinetics of Phase Transformations</td>
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<td>Lecture / Blended (On-Site/Online)</td>
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<td>Franke</td>
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Exams

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<tr>
<td>ST 2021</td>
<td>76-T-MACH-107667</td>
<td>Solid State Reactions and Kinetics of Phase Transformations</td>
<td>Seifert, Franke</td>
</tr>
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</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🗑 Cancelled

Competence Certificate
oral examination (about 30 min)

Prerequisites
The successful participation in Übungen zu Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion is the condition for the admittance to the oral exam in Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion.

T-MACH-110926 – Exercises for Solid State Reactions and Kinetics of Phase Transformations has not been started.

T-MACH-110927 – Solid State Reactions and Kinetics of Phase has not been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107632 - Exercises for Solid State Reactions and Kinetics of Phase Transformations must have been passed.

Recommendation
Basic course in materials science and engineering
Basic course in mathematics
Physical chemistry

Below you will find excerpts from events related to this course:
Content
Oral examination (about 30 min)
Teaching Content:
1. Crystal Defects and Mechanisms of Diffusion
2. Microscopic Description of Diffusion
3. Phenomenological Treatment
4. Diffusion Coefficients
5. Diffusion Problems; Analytical Solutions
6. Diffusion with Phase Transformation
7. Kinetics of Microstructural Transformations
8. Diffusion at Surfaces, Grain Boundaries and Dislocations

Recommendations:
knowledge of the course "Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria" (Seifert); Basic course in materials science and Engineering; Basic course in mathematics; physical chemistry
regular attendance: 22 hours
self-study: 98 hours

The students acquire knowledge about:
- diffusion mechanisms
- Fick's laws
- basic solutions of the diffusion equation
- evaluation of diffusion experiments
- interdiffusion processes
- the thermodynamic factor
- parabolic growth of layers
- formation of pearlite
- microstructural transformations according to the models of Avrami and Johnson-Mehl
- TTT diagrams

Literature


**10.417 Course: Stability: from Order to Chaos [T-MACH-108846]**

**Responsible:** apl. Prof. Dr. Andreas Class  
**Organisation:** KIT Department of Mechanical Engineering

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**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

**Events**

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<td>2 SWS</td>
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**Exams**

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**Legend:** Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

The study performance is considered to have been passed if all exercise assignments have been successfully processed and the final colloquium (30 minutes) has been successfully passed.

No auxiliary

**Prerequisites**

The partial performance number T-MACH-105425 "Hydrodynamic Stability: From Order to Chaos" must not be started or completed. The partial services T-MACH-108846 "Stability: from order to chaos" (Nat/Inf/Elit) and T-MACH-105425 "Hydrodynamic Stability: From Order to Chaos" are mutually exclusive.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-105425 - Hydrodynamic Stability: From Order to Chaos must not have been started.

**Recommendation**

Fluid Mechanics (T-MACH-105207)  
Mathematical Methods in Fluid Mechanics (T-MACH-105295)

**Below you will find excerpts from events related to this course:**

**Hydrodynamic Stability: From Order to Chaos**

2154437, SS 2021, 2 SWS, Language: German/English, Open in study portal

**Lecture (V) Online**

**Content**

The students can apply the analytic and numerical methods for an evaluation of stability properties of hydrodynamic systems. They are qualified to discuss the characteristic influence of parameter changes (e.g. Reynolds number) on the calculated results with respect to the flow character and properties (e.g. transition laminar/turbulent flow).

Increasing a control parameter of a thermohydraulic system, e.g. the Reynolds number, the initial flow pattern (e.g. stationary flow) can be replaced by a different pattern (e.g. turbulent flow).

Typical hydrodynamic instabilities are summarized in the lecture. The systematic analysis of thermohydraulic stability problems is developed for the case of Rayleigh-Bernard convection (fluid layer heated from below) and selected examples from fluid dynamics.

Covered is:

- linear stability analysis: determine limiting control parameter value up to which the basic flow pattern is stable against small perturbations
- nonlinear reduced order modeling, capable to characterize more complex flow patterns
- Lorenz system: a generic system exhibiting chaotic behavior
Literature
Vorlesungsskript
10 COURSES  Course: Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example [T-MACH-110961]

10.418 Course: Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example [T-MACH-110961]

Responsible: Dr. Rudolf Maier
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102824 - Key Competences

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Events

| WT 21/22 | 2149663 | Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example | 2 SWS | Seminar / Blended (On-Site/Online) | Maier |

Exams

| WT 21/22 | 76-T-MACH-110961 | Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example | Maier |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
alternative achievement (ungraded):
- attendance on at least 12 lecture units

Prerequisites
T-MACH-106375 – The Value Stream in an Industrial Company - The Value Chain at BOSCH as an Example must not have been started.

Below you will find excerpts from events related to this course:

Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example

2149663, WS 21/22, 2 SWS, Language: German, Open in study portal

Seminar (S) Blended (On-Site/Online)
Content
The seminar provides an insight into the main functional units of a company and their typical processes by using Bosch as an example. Furthermore it is based on discussions with the students. Former Bosch top managers explain the essential business processes and functions of the individual departments as well as the classic tasks of an engineer in a worldwide operating automotive supplier. The seminar also provides an insight into the careers of the Bosch directors. In addition to the company processes, the seminar will therefore focus on reports of challenges, successes, failures and product and process innovations.

The topics are as follows:

- Introduction, strategy, innovation
- R&D, product development process
- Production
- Quality management
- 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
Start: 20.10.2021
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/).
10.419 Course: Strategic Product Development - Identification of Potentials of Innovative Products [T-MACH-105696]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Dr.-Ing. Andreas Siebe

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

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<td>Each summer term</td>
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Events

ST 2021 2146198 Strategic product development - identification of potentials of innovative products 2 SWS Lecture / Online Siebe

Exams

ST 2021 76-T-MACH-105696 Strategic product development - identification of potentials of innovative products Siebe, Albers

Competence Certificate

Oral exam in small groups (30 minutes)

Prerequisites

The precondition of this partial work is the successful processing of a case study (T-MACH-110396): Documentation and presentation of the overall results (15 minutes)

Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-110396 - Strategic Product Development - Identification of Potentials of Innovative Products - Case Study must have been passed.

Below you will find excerpts from events related to this course:

Strategic product development - identification of potentials of innovative products

2146198, SS 2021, 2 SWS, Language: German, Open in study portal

Lecture (V) Online

Content

Introduction into future management, Development of scenarios, scenario-based strategy development, trend management, strategic early detection, innovation- and technology management, 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
10.420 Course: Strategic Product Development - Identification of Potentials of Innovative Products - Case Study [T-MACH-110396]

**Responsible:** Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Sven Matthiesen  
Dr.-Ing. Andreas Siebe  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102599 - Major Field: Powertrain Systems  
- M-MACH-102605 - Major Field: Engineering Design  
- M-MACH-102607 - Major Field: Vehicle Technology  
- M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

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**Events**

| ST 2021 | 2146198 | Strategic product development - identification of potentials of innovative products | 2 SWS | Lecture / 🖥 | Siebe |

**Exams**

| ST 2021 | 76-T-MACH-110396 | Strategic Product Development - Identification of Potentials of Innovative Products - Case Study | Siebe |

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**Competence Certificate**

Successful processing of a case study (T-MACH-110396): documentation and presentation of the overall results (15 minutes)

**Below you will find excerpts from events related to this course:**

**V** Strategic product development - identification of potentials of innovative products  
2146198, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**

Introduction into future management, Development of scenarios, scenario-based strategy development, trend management, strategic early detection, innovation- and technology management, 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
10.421 Course: Structural Analysis of Composite Laminates [T-MACH-105970]

Responsible: Dr.-Ing. Luise Kärger
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102613 - Major Field: Lifecycle Engineering
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102632 - Major Field: Polymer Engineering
M-MACH-102646 - Major Field: Applied Mechanics

Type: Oral examination
Credits: 4
Grading scale: Grade to a third
Recurrence: Each winter term
Version: 1

Events

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<td>2 SWS</td>
<td>Lecture / Practice ( / Kärger</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
oral exam, 20 min

Prerequisites
none

Below you will find excerpts from events related to this course:

Structural Analysis of Composite Laminates
2113106, WS 21/22, 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 plastics (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 understand the mechanical correlation between fibre-matrix-configuration and macroscopic material behavior. They can 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 know and can interpret and apply failure criteria and approaches to model damage progression. They know simple dimension strategies to design FRP components.
Literature
10.422 Course: Structural and Phase Analysis [T-MACH-102170]

**Responsible:** Dr. Manuel Hinterstein  
Dr.-Ing. Susanne Wagner

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

**Type**  
Oral examination

**Credits**  
4

**Grading scale**  
Grade to a third

**Recurrence**  
Each winter term

**Version**  
1

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**Events**

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<td>Grade to a third</td>
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**Exams**

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<td>Structural and Phase Analysis</td>
<td>Wagner, Hinterstein</td>
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**Literature**

1. Moderne Röntgenbeugung - Röntgendiffрактометрия für Materialwissenschaftler, Physiker und Chemiker, Spieß, Lothar / Schwarzer, Robert / Behken, Herfried / Teichert, Gerd B.G. Teubner Verlag 2005

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**Competence Certificate**

Oral examination

**Prerequisites**

none

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**Below you will find excerpts from events related to this course:**

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**Structural and phase analysis**

2125763, WS 21/22, 2 SWS, Language: German, Open in study portal

Lecture (V)

On-Site

---

Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021  
Module Handbook, valid from Winter Term 2021/2022
10.423 Course: Structural Ceramics [T-MACH-102179]

**Responsible:** Prof. Dr. Michael Hoffmann  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102611 - Major Field: Materials Science and Engineering  
- M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

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**Events**

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**Exams**

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<td>Structural Ceramics</td>
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<td>Structural Ceramics</td>
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</tr>
</tbody>
</table>

Legend: 📰 Online, 🔄 Blended (On-Site/Online), 🗿 On-Site, 🗿 Cancelled

**Competence Certificate**

Oral examination, 20 min

**Prerequisites**

None

Below you will find excerpts from events related to this course:

**Literature**


10.424 Course: Structural Materials [T-MACH-100293]

Responsible: Dr.-Ing. Stefan Guth
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

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Events

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<td>Structural Materials</td>
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Exams

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<td>Guth</td>
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</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

Competence Certificate

Oral exam, about 25 minutes

Prerequisites

none

Below you will find excerpts from events related to this course:

V Structural Materials

2174580, SS 2021, 4 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
Blended (On-Site/Online)

Content

The lectures will be held online. Further information will be available on ILIAS.

Lectures and tutorialy on the topics:
- basic loading types and superimposed loadings
- high-temperature loading
- influence of notches
- uniaxial, multiaxial and superimposed cyclic loading
- notch fatigue
- structural durability
- impact of residual stresses
- basic principles of materials selection
- dimensioning of components

Learning objectives:

The students are able to select materials for mechanical design and to dimension structural components according to the state of the art. They are familiar with the most important engineering materials. They can assess these materials on base of their characteristic properties and and they can match property profiles and requirement profiles. The dimensioning includes complex situations, such as multiaxial loading, notched components, static and dynamic loading, components with residual stresses and loading at high homologous temperatures.

Requirements:

none

Workload:

Presence: 42h
Self study: 138h
### 10.425 Course: Superconductors for Energy Applications [T-ETIT-110788]

**Responsible:** apl. Prof. Dr. Francesco Grilli  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

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#### Exams

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<td>7312682</td>
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**Legend:**  
- 📲 Online,  
- 🎥 Blended (On-Site/Online),  
- 🗣 On-Site,  
- ✗ Cancelled

**Competence Certificate**  
Written exam approx. 90 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 superconducting materials for energy applications must not be taken.
**10.426 Course: Superhard Thin Film Materials [T-MACH-102103]**

**Responsible:** apl. Prof. Dr. Sven Ulrich  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102637 - Major Field: Tribology

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**Events**

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<td>Superhard Thin Film Materials</td>
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**Exams**

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<td>Ulrich</td>
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</table>

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

oral examination (ca. 30 Minuten)

**Prerequisites**

none

**Below you will find excerpts from events related to this course:**

**Superhard Thin Film Materials**

2177618, WS 21/22, 2 SWS, Language: German, Open in study portal

Lecture (V)  
On-Site
Content
oral examination (about 30 min), no tools or reference materials
Teaching Content:
Introduction
Basics
Plasma diagnostics
Particle flux analysis
Sputtering and ion implantation
Computer simulations
Properties of materials, thin film deposition technology, thin film analysis and modelling of superhard materials
Amorphous hydrogenated carbon
Diamond like carbon
Diamond
Cubic Boronitride
Materials of the system metall-boron-carbon-nitrogen-silicon
regular attendance: 22 hours
self-study: 98 hours
Superhard materials are solids with a hardness higher than 4000 HV 0.05. The main topics of this lecture are modelling, deposition, characterization and application of superhard thin film materials.
Recommendations: none

Organizational issues
Achtung: Die Vorlesung beginnt erst am Donnerstag, 28.10.2021!
Falls die Vorlesung online stattfinden muss, bitte um Anmeldung unter sven.ulrich@kit.edu bis zum 10.10.21. Den entsprechenden MS Teams Link erhalten Sie dann per E-Mail am 11.10.21.

Literature
G. Kienel (Herausgeber): Vakuumbeschichtung 1 - 5, VDI Verlag, Düsseldorf, 1994

Abbildungen und Tabellen werden verteilt; Copies with figures and tables will be distributed
Course: Sustainable Product Engineering [T-MACH-105358]

**Responsible:** Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Sven Matthiesen  
Dr. Karl-Friedrich Ziegahn

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102599 - Major Field: Powertrain Systems  
M-MACH-102605 - Major Field: Engineering Design  
M-MACH-102607 - Major Field: Vehicle Technology  
M-MACH-102613 - Major Field: Lifecycle Engineering  
M-MACH-102614 - Major Field: Mechatronics  
M-MACH-102623 - Major Field: Fundamentals of Energy Technology  
M-MACH-102633 - Major Field: Robotics  
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

**Type:** Written examination  
**Credits:** 4  
**Grading scale:** Grade to a third  
**Recurrence:** Each summer term  
**Version:** 1

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**Events**

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<td>Sustainable Product Engineering</td>
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**Exams**

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</table>

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

written exam (60 min)

**Prerequisites**

none

---

Below you will find excerpts from events related to this course:

**Sustainable Product Engineering**

2146192, SS 2021, 2 SWS, Open in study portal

Lecture (V)  
Online

**Content**

understanding of sustainability objectives and their role in product development, the interaction between technical products and their environment, the holistic approach and the equality of economic, social and environmental aspects and environmental aspects.

skills for life-cycle product design using the example of complex automotive components such as airbag systems and other current products.

understanding of product environmental stresses with relevancy to praxis at the example of technology-intensive components, robustness and durability of products as the basis for a sustainable product development, development of skills for the application of environmental simulation during the process of development of technical products.

delivery of key skills such as team skills / project / self / presentation based on realistic projects.

The goal of the lecture is to convey the main elements of sustainable product development in the economic, social and ecological context.

The students are able to ...

- identify und describe the sustainability objectives and their role in product development, the interaction between technical products and their environment, the holistic approach and the equality of economic, social and environmental aspects and environmental aspects.
- discuss the skills for life-cycle product design using the example of complex automotive components such as airbag systems and other current products.
- understand the product environmental stresses with relevancy to praxis at the example of technology-intensive components, robustness and durability of products as the basis for a sustainable product development, development of skills for the application of environmental simulation during the process of development of technical products.
- develop skills such as team skills / project / self / presentation based on realistic projects.
Organizational issues
Die zusätzliche Vorlesungstermine für Blockvorlesung finden in Räumen des IPEKs statt.
26. Mai 2020 – Blockvorlesung von 9:00 bis 17:00 Uhr
16. Juni 2020 – Blockvorlesung von 9:00 bis 17:00 Uhr
22. Juni 2020 – Blockvorlesung 14:00h-17:00h
Weitere Info siehe IPEK-Homepage
https://www.ipek.kit.edu/70_2831.php
10.428 Course: Sustainable Vehicle Drivetrains [T-MACH-111578]

**Responsible:** Prof. Dr. Thomas Koch
Dr.-Ing. Olaf Toedter

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-102627 - Major Field: Energy Converting Engines
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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**Exams**

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**
oral exam (20 minutes)

**Prerequisites**
none

Below you will find excerpts from events related to this course:

**Sustainable Vehicle Drivetrains**
2133132, WS 21/22, 2 SWS, Open in study portal

**Content**
History
Infrastructure
Market Situation
Legislation
Alternative Fuels
Innovative Drivetrains
Hybrids
Plug-In Hybrids
BEV
Fuel Cells

**Organizational issues**
Die Vorlesung beginnt um 14 h und endet um 15:30 h (nicht um 17:30 h)
10 COURSES
Course: System Integration in Micro- and Nanotechnology [T-MACH-105555]

T 10.429 Course: System Integration in Micro- and Nanotechnology [T-MACH-105555]

Responsible: Dr. Ulrich Gengenbach
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102601 - Major Field: Automation Technology
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102615 - Major Field: Medical Technology
- M-MACH-102633 - Major Field: Robotics
- M-MACH-102647 - Major Field: Microactuators and Microsensors

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Events

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Exams

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<td>System Integration in Micro- and Nanotechnology</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗓 On-Site, ✗ Cancelled

Competence Certificate
oral exam (Duration: 30 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

System Integration in Micro- and Nanotechnology I
2106033, SS 2021, 2 SWS, Language: German, Open in study portal

Content

- Introduction to system integration (fundamentals)
- Brief introduction to MEMS processes
- Flexures
- Surfaces and plasma processes for surface treatment
- Adhesive bonding in engineering
- Mounting techniques in electronics
- Molded Interconnect devices (MID)
- Functional Printing
- Low temperature cofired ceramics in system integration
- 3D-Integration in semiconductor technology

Learning objectives:
The students acquire basic knowledge of challenges and system integration technologies from mechanical engineering, precision engineering and electronics.
Literature

- J. Franke, Räumliche elektronische Baugruppen (3D-MID), Carl Hanser-Verlag München, 2013
10.430 Course: System Integration in Micro- and Nanotechnology 2 [T-MACH-110272]

**Responsible:** Dr. Ulrich Gengenbach  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102598 - Major Field: Advanced Mechatronics  
- M-MACH-102601 - Major Field: Automation Technology  
- M-MACH-102614 - Major Field: Mechatronics  
- M-MACH-102615 - Major Field: Medical Technology  
- M-MACH-102633 - Major Field: Robotics  
- M-MACH-102647 - Major Field: Microactuators and Microsensors

### Events

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**Events**  
WT 21/22  
2105040  
System Integration in Micro- and Nanotechnology 2  
2 SWS  
Lecture / 🗣  
Gengenbach

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

### Competence Certificate

Oral exam, approx. 15 min.

### Prerequisites

None

### Annotation

Attention: The lecture and exam will be offered for the first time in WS20/21!

Below you will find excerpts from events related to this course:

**System Integration in Micro- and Nanotechnology 2**  
2105040, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)  
Lecture (V)  
On-Site

### Content

**Introduction**

Introduction to system integration (novel processes and applications)

**Assembly of hybrid microsystems**

**Packaging processes**

**Applications:**

- Micro process engineering
- 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
10.431 Course: Systematic Materials Selection [T-MACH-100531]

**Responsible:** Dr.-Ing. Stefan Dietrich  
Prof. Dr.-Ing. Volker Schulze  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering  
- M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering  
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering  
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology  
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction  
- M-MACH-102742 - Fundamentals and Methods of Production Technology  
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering  
- M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

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<td>Each summer term</td>
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**Events**

| ST 2021 | 2174576 | Systematic Materials Selection | 3 SWS | Lecture / 📘 | Dietrich |
| ST 2021 | 2174577 | Übungen zu 'Systematische Werkstoffauswahl' | 1 SWS | Practice / 📘 | Dietrich, Mitarbeiter |

**Exams**

| ST 2021 | 76-T-MACH-100531 | Systematic Materials Selection | Dietrich |

Legend: 📘 Online, ⬤ Blended (On-Site/Online), 🗣 On-Site, ☓ Cancelled

**Competence Certificate**

The assessment is carried out as a written exam of 2 h.

**Prerequisites**

none

**Recommendation**

Basic knowledge in materials science, mechanics and mechanical design due to the lecture Materials Science I/II.

**Below you will find excerpts from events related to this course:**

**Systematic Materials Selection**

2174576, SS 2021, 3 SWS, Language: German, Open in study portal
Content
Important aspects and criteria of materials selection are examined and guidelines for a systematic approach to materials selection are developed. The following topics are covered:

• Information and introduction
• Necessary basics of materials
• Selected methods / approaches of the material selection
• Examples for material indices and materials property charts
• Trade-off and shape factors
• Sandwich materials and composite materials
• High temperature alloys
• Regard of process influences
• Material selection for production lines
• Incorrect material selection and the resulting consequences
• Abstract and possibility to ask questions

Learning objectives:
The students are able to select the best material for a given application. They are proficient in selecting materials on base of performance indices and materials selection charts. They can identify conflicting objectives and find sound compromises. They are aware of the potential and the limits of hybrid material concepts (composites, bimaterials, foams) and can determine whether following such a concept yields a useful benefit.

Requirements:
Wiling SPO 2007 (B.Sc.)
The course Material Science I [21760] has to be completed beforehand.

Wiling (M.Sc.)
The course Material Science I [21760] has to be completed beforehand.

Workload:
The workload for the lecture is 120 h per semester and consists of the presence during the lecture (30 h) as well as preparation and rework time at home (30 h) and preparation time for the oral exam (60 h).

Literature
Vorlesungsskriptum; Übungblätter; Lehrbuch: M.F. Ashby, A. Wanner (Hrsg.), C. Fleck (Hrsg.);
Materials Selection in Mechanical Design: Das Original mit Übersetzungshilfen
Easy-Reading-Ausgabe, 3. Aufl., Spektrum Akademischer Verlag, 2006
ISBN: 3-8274-1762-7

Lecture notes; Problem sheets; Textbook: M.F. Ashby, A. Wanner (Hrsg.), C. Fleck (Hrsg.);
Materials Selection in Mechanical Design: Das Original mit Übersetzungshilfen
Easy-Reading-Ausgabe, 3. Aufl., Spektrum Akademischer Verlag, 2006
ISBN: 3-8274-1762-7
Course: Technical Acoustics [T-MACH-111382]

**Responsible:** Dr. Iris Pantle
Johannes Walter

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102605 - Major Field: Engineering Design
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
- M-MACH-102610 - Major Field: Power Plant Technology
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology

### Events

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**Exams**

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Legend: 🕵️ Online, 🧩 Blended (On-Site/Online), ⚠️ On-Site, ⚠️ Cancelled

### Competence Certificate

oral exam, 30 min.

### Prerequisites

None

### Below you will find excerpts from events related to this course:

**Technical Acoustics**

2158107, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**

Basics of acoustics
Perception and weighting of noise (human hearing)
Description of acoustic parameters, level notation
Noise propagation

Acoustical measurement techniques
regular attendance: 28 hours
self-study: 60 hours
preparation for exam: 30 hours

Oral examination
Duration: 30 minutes
No tools or reference materials may be used during the exam.

WARNING for ETIT students: the recognition is not possible because the Faculty of Electrical Engineering and Information Technology also offers a "Technical Acoustics" course.

Students get to know the basics of technical acoustics in general. Application of the knowledge in different fields of engineering.

Students learn physical basics of acoustics and human perception. Physical-empirical laws for determination of sound and noise levels of various emission and immission situations will be worked out or derived. Furtheron general sound measurement methods of machinery will be taught.

Students are able to understand mechanisms of sound origin, propagation and reduction, as well as measuring technics

### Literature

1. Vorlesungsskript (von Homepage des Instituts herunterladbar).
### 10.433 Course: Technical and environmental historical perspectives on current innovation processes [T-GEISTSOZ-110845]

**Responsible:** Prof. Dr. Marcus Popplow  
**Organisation:** KIT Department of Humanities and Social Sciences  
**Part of:** M-MACH-102596 - Compulsory Elective Subject Economics/Law

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**Exams**

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**Prerequisites**

none

*Legend:* 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🗑 Cancelled*
10.434 Course: Technical Design in Product Development [T-MACH-105361]

**Responsible:** Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Sven Matthiesen  
Dr.-Ing. Markus Schmid

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102600 - Major Field: Man - Technology - Organisation  
M-MACH-102605 - Major Field: Engineering Design

**Type**  
Written examination

**Credits**  
4

**Grading scale**  
Grade to a third

**Recurrence**  
Each summer term

**Version**  
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Legend: 📅 Online, 🤗 Blended (On-Site/Online), 🗒 On-Site, ✗ Cancelled

**Competence Certificate**

Written exam (60 min)  
Only dictionary is allowed

**Below you will find excerpts from events related to this course:**

**Technical Design in Product Development**  
2146179, SS 2021, 2 SWS, Language: German, Open in study portal

**Lecture (V) Online**

**Content**

Introduction  
Relevant parameters on product value in Technical Design  
Design in Methodical Development and Engineering and for a differentiated validation of products  
Design in the concept stage of Product Development  
Design in the draft and elaboration stage of Product Development  

**Best Practice**

After listening the module “technical design” the students should have knowledge about the basics of technical oriented design as an integral part of the methodical product development

The students have knowledge about...

- the interface between engineer and designer.
- all relevant human-product requirements as f. exp. demographic/ geographic and psychographic features, relevant perceptions, typical content recognition as well as ergonomic bases.
- the approaches concerning the design of a product, product program or product system with focus on structure, form-, color- and graphic design within the phases of the design process.
- the design of functions and supporting structures as well as the important interface between human and machine.
- relevant parameters of a good corporate design.

**Organizational issues**


**Erster Vorlesungstermin:** wird noch bekanntgegeben
Literature
Markus Schmid, Thomas Maier
Technisches Interface Design
Anforderungen, Bewertung, Gestaltung.
2017
Hartmut Seeger
Design technischer Produkte, Produktprogramme und -systeme
Industrial Design Engineering.
2 . bearb. und erweiterte Auflage.
ISBN: 3540236538
September 2005 - gebunden - 396 Seiten

Responsible: Dr. Ferdinand Schmidt
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102648 - Major Field: Energy Technology for Buildings

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Legend: 🖥 Online, 📓 Blended (On-Site/Online), 🗝 On-Site, ❌ Cancelled

Competence Certificate
oral exam, approx. 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

Technical energy systems for buildings 1: Processes & components
2157200, WS 21/22, 2 SWS, Language: German, Open in study portal

Lecture (V) Blended (On-Site/Online)

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

**Responsible:** Dr. Ferdinand Schmidt  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102648 - Major Field: Energy Technology for Buildings

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**Prerequisites**

None

**Compentence Certificate**

Oral exam, approx. 30 minutes

Below you will find excerpts from events related to this course:

Technical energy systems for buildings 2: System concepts  
2158201, SS 2021, 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
10.437 Course: Technology of Steel Components [T-MACH-105362]

**Responsible:** Prof. Dr.-Ing. Volker Schulze

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102611 - Major Field: Materials Science and Engineering
- M-MACH-102618 - Major Field: Production Technology

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**Competence Certificate**
Oral exam, about 25 minutes

**Prerequisites**
none

**Below you will find excerpts from events related to this course:**

**Technology of steel components**
2174579, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**
Meaning, Development and characterization of component states
Description of the influence of component state on mechanical properties
Stability of component states
Steel manufacturing
Component states due to forming
Component states due to heat treatments
Component states due to surface hardening
Component states due to machining
Component states due to mechanical surface treatments
Component states due to joining
Summarizing evaluation

**Learning Objectives:**
The students have the background to evaluate the influence of manufacture processes on the compound state of metallic compounds. The students can assess the influence and the stability of compound state under mechanical load. The students are capable to describe the individual aspects of interaction of the compound state of steel components due to forming, heat treatment, mechanical surface treatment and joining processes.

**Requirements:**
Materials Science and Engineering I & II

**Workload:**
regular attendance: 21 hours
self-study: 99 hours
Literature
Skript wird in der Vorlesung ausgegeben

VDEh: Werkstoffkunde Stahl, Bd. 1: Grundlagen, Springer-Verlag, 1984


V. Schulze: Modern Mechanical Surface Treatments, Wiley, Weinheim, 2005
10.438 Course: Ten Lectures on Turbulence [T-MACH-105456]

Responsible: Dr. Ivan Otic
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102608 - Major Field: Nuclear Energy
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102643 - Major Field: Fusion Technology

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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
oral exam, 20 min

Prerequisites
none

Below you will find excerpts from events related to this course:

Ten lectures on turbulence
2189904, WS 21/22, 2 SWS, Language: English, Open in study portal

Content

Contents:
The course is aimed of giving the fundamentals of turbulence theory, modelling and simulation. Governing equations and statistical description of turbulence are introduced. Reynolds equations, Kolmogorov's theory and scales of turbulent flows are discussed. Homogeneous and isotropic turbulence, Turbulent free-shear flows and wall-bounded turbulent flows are discussed. Turbulence modelling approaches and simulation methods are introduced.

1 Introduction
2 Turbulent transport of momentum and heat
3 Statistical description of turbulence
4 Scales of turbulent flows
5 Homogeneous turbulent shear flows
6 Free turbulent shear flows
7 Wall-Bounded turbulent flows
8 Turbulence Modelling
9 Reynolds Averaged Navier-Stokes (RANS) Simulation Approach
10 Large Eddy Simulation (LES) Approach

Objectives:
At the completion of this course, students
- are able to understand fundamentals of statistical fluid mechanics, turbulence theory and turbulence modelling
- are able to derive RANS and LES transport equations
- get working knowledge of modelling techniques that can be used for solving engineering heat and mass transfer problems.

Literature

Reference texts:
- Lecture Notes
- Presentation slides

Recommended Books:
**Course: Theoretical Description of Mechatronic Systems [T-MACH-105521]**

**Responsible:** Prof. Dr.-Ing. Wolfgang Seemann  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102598 - Major Field: Advanced Mechatronics  
M-MACH-102614 - Major Field: Mechatronics

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**Competence Certificate**

oral exam, approx. 30 min.

**Prerequisites**

none

**Below you will find excerpts from events related to this course:**

**Theoretical Description of Mechatronic Systems**

2161117, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**

**Content**

Aim of the course is to provide principles and tools to derive the mathematical models of mechatronic systems. The students are able to generate physical models of mechatronic systems. They know the description by across and through variables. With the help of energy principles variational methods can be applied to electromechanic systems. The basics of applied mechanics and of electric systems are known. The students are able to complete the mechatronic system by a corresponding tool.

**Organizational issues**

Vorlesung wird im WS 2021/22 nicht angeboten.
**10.440 Course: Theory of Stability [T-MACH-105372]**

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102646 - Major Field: Applied Mechanics
- M-MACH-104443 - Major Field: Vibration Theory

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**Events**

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**ST 2021**

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**Competence Certificate**
oral exam, 30 min.

**Prerequisites**
none

**Recommendation**
Vibration theory, Mathematical Methods of Vibration Theory

**Below you will find excerpts from events related to this course:**

**Theory of Stability**

2163113, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V) Online**

**Content**

- Basic concepts of stability
- Lyapunov's functions
- Direct lyapunov's methods
- Stability of equilibria positions
- Attraction area of a stable solution
- Stability according to the first order approximation
- Systems with parametric excitation
- Stability criteria in the control theory

**Literature**

10.441 Course: Thermal Solar Energy [T-MACH-105225]

**Responsible:** Prof. Dr. Robert Stieglitz  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102610 - Major Field: Power Plant Technology  
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology  
- M-MACH-102648 - Major Field: Energy Technology for Buildings

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<td>Thermal Solar Energy</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Oral examination of about 30 minutes

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

**V Thermal Solar Energy**

2169472, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)
Content

In detail:
1 Introduction to energy requirements and evaluation of the potential use of solar thermal energy.
2 Primary energy source SUN: sun, solar constant, radiation (direct, diffuse scattering, absorption, impact angle, radiation balance).
3 Solar collectors: schematic structure of a collector, fundamentals of efficiency, meaning of concentration and their limitations.
5 Momentum and heat transport: basic equations of single and multiphase transport, calculation methods, stability limits.
optional
6 Low temperature solar thermal systems: collector types, methods for system simulation, planning and dimensioning of systems, system design and stagnation scenarios.
7 High temperature solar thermal systems: solar towers and solar-farm concept, loss mechanisms, chimney power plants and energy production processes

The lecture elaborates the basics of the solar technology and the definition of the major wordings and its physical content such as radiation, thermal use, insulation etc.. Further the design of solar collectors for different purposes is discussed and analyzed. The functional principle of solar plants is elaborated before at the end the ways for solar cooling is discussed.

The aim of the course is to provide the basic physical principles and the derivation of key parameters for the individual solar thermal use. This involves in addition to the selective absorber, mirrors, glasses, and storage technology. In addition, a utilization of solar thermal energy means an interlink of the collector with a thermal-hydraulic circuit and a storage. The goal is to capture the regularities of linking to derive efficiency correlations as a function of their use and evaluate the performance of the entire system.

Recommendations / previous knowledge
Basics in heat and mass transfer, material science and fluid mechanics, desirable are reliable knowledge in physics in optics and thermodynamics
Oral exam of about 25 minutes, no tools or reference materials may be used during the exam

Organizational issues
Die Veranstaltung wird nur online gehalten, falls durch Corona Einschränkungen vorgegeben werden.

Literature
Bereitstellung des Sudienmaterials in gedruckter und elektronischer Form.
**10.442 Course: Thermal Turbomachines I [T-MACH-105363]**

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102610 - Major Field: Power Plant Technology  
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology  
- M-MACH-102627 - Major Field: Energy Converting Engines  
- M-MACH-102635 - Major Field: Engineering Thermodynamics  
- M-MACH-102636 - Major Field: Thermal Turbomachines

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Legend: 🗣️ Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, x Cancelled

**Competence Certificate**
oral exam, duration 30 min.

**Prerequisites**
none

Below you will find excerpts from events related to this course:

**Thermal Turbomachines I**  
2169453, WS 21/22, 3 SWS, Language: German, Open in study portal
Content
Basic concepts of thermal turbomachinery
Steam Turbines - Thermodynamic process analysis
Gas Turbines - Thermodynamic process analysis
Combined cycle and cogeneration processes
Overview of turbomachinery theory and kinematics
Energy transfer process within a turbine stage
Types of turbines (presented through examples)
1-D streamline analysis techniques
3-D flow fields and radial momentum equilibrium in turbines
Compressor stage analysis and future trends in turbomachinery

The students are able to explain and comment on the design and operation of thermal turbomachines in detail. Moreover, they can evaluate the range of applications for turbomachinery. Therefore, students are able to describe and analyse not only the individual components but also entire assemblies. The students can assess and evaluate the effects of physical, economical and ecological boundary conditions.

regular attendance: 31.50 h
self-study: 64.40 h

Recommendations:
Recommended in combination with the lecture ‘Thermal Turbomachines II’.

Examination:
oral
Duration: approximately 30 min

no tools or reference materials may be used during the exam

Organizational issues
Vorlesung findet in Präsenz statt, sofern es die COVID-Inzidenzwerte zulassen.

Literature
Vorlesungsskript (erhältlich im Internet)

Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993
Content
Basic concepts of thermal turbomachinery
Steam Turbines - Thermodynamic process analysis
Gas Turbines - Thermodynamic process analysis
Combined cycle and cogeneration processes
Overview of turbomachinery theory and kinematics
Energy transfer process within a turbine stage
Types of turbines (presented through examples)
1-D streamline analysis techniques
3-D flow fields and radial momentum equilibrium in turbines
Compressor stage analysis and future trends in turbomachinery

Recommendations:
Recommended in combination with the lecture ‘Thermal Turbomachines II’.
The students are able to explain and comment on the design and operation of thermal turbomachines in detail. Moreover, they can evaluate the range of applications for turbomachinery. Therefore, students are able to describe and analyse not only the individual components but also entire assemblies. The students can assess and evaluate the effects of physical, economical and ecological boundary conditions.
regular attendance: 31,50 h
self-study: 64,40 h

Exam:
oral
Duration: approximately 30 min
no tools or reference materials may be used during the exam

Organizational issues
Veranstaltung wird in Präsenz angeboten, sofern es die COVID-Inzidenzwerte zulassen

Literature
Vorlesungsskript (erhältlich im Internet)
Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993
10.443 Course: Thermal Turbomachines II [T-MACH-105364]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102610 - Major Field: Power Plant Technology  
- M-MACH-102627 - Major Field: Energy Converting Engines  
- M-MACH-102635 - Major Field: Engineering Thermodynamics  
- M-MACH-102636 - Major Field: Thermal Turbomachines

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<td>Thermal Turbomachines II (in English)</td>
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<td>Lecture / Practice / 🕵️‍♂️</td>
<td>Bauer, Mitarbeiter</td>
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**Exams**

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**Legend:** 🕵️‍♂️ Online, 🕵️‍♂️ Blended (On-Site/Online), 🗣️ On-Site, ⌠ Cancelled

**Competence Certificate**

oral exam, duration: 30 min.

**Prerequisites**

none

Below you will find excerpts from events related to this course:

**Thermal Turbomachines II**

2170476, SS 2021, 3 SWS, Language: German, [Open in study portal](#)
Content
General overview, trends in design and development
Comparison turbine - compressor
Integrating resume of losses
Principal equations and correlations in turbine and compressor design, stage performance
Off-design performance of multi-stage turbomachines
Control system considerations for steam and gas turbines
Components of turbomachines
Critical components
Materials for turbine blades
Cooling methods for turbine blades (steam and air cooling methods)
Short overview of power plant operation
Combustion chamber and environmental issues
Based on the fundamental skills learned in 'Thermal Turbomachines I' the students have the ability to design turbines and compressors and to analyse the operational behavior of these machines.
Recommendations:
Recommended in combination with the lecture 'Thermal Turbomachines I'.
regular attendance: 31,50 h
self-study: 64,40 h
Exam:
oral (can only be taken in combination with 'Thermal Turbomachines I')
Duration: 30 min ( --> 1 hour including Thermal Turbomachines I)
Auxiliary: no tools or reference materials may be used during the exam

Literature
Vorlesungsskript (erhältlich im Internet)
Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993

Thermal Turbomachines II (in English)
2170553, SS 2021, 3 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
Blended (On-Site/Online)
Content
Basic concepts of thermal turbomachinery
Steam Turbines - Thermodynamic process analysis
Gas Turbines - Thermodynamic process analysis
Combined cycle and cogeneration processes
Overview of turbomachinery theory and kinematics
Energy transfer process within a turbine stage
Types of turbines (presented through examples)
1-D streamline analysis techniques
3-D flow fields and radial momentum equilibrium in turbines
Compressor stage analysis and future trends in turbomachinery

Recommendations:
Recommended in combination with the lecture 'Thermal Turbomachines II'.
regular attendance: 31,50 h
self-study: 64,40 h
The students are able to explain and comment on the design and operation of thermal turbomachines in detail. Moreover, they can evaluate the range of applications for turbomachinery. Therefore, students are able to describe and analyse not only the individual components but also entire assemblies. The students can assess and evaluate the effects of physical, economical and ecological boundary conditions.

Exam:
oral
Duration: approximately 30 min
no tools or reference materials may be used during the exam.

Literature
Vorlesungsskript (erhältlich im Internet)
Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993
10.444 Course: Thermal-Fluid-Dynamics [T-MACH-106372]

**Responsible:** Dr. Sebastian Ruck

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102610 - Major Field: Power Plant Technology
- M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
- M-MACH-102634 - Major Field: Fluid Mechanic
- M-MACH-102643 - Major Field: Fusion Technology
- M-MACH-102648 - Major Field: Energy Technology for Buildings

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**Exams**

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**
oral exam of about 30 minutes

**Prerequisites**
none

Below you will find excerpts from events related to this course:

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<td>2189423, WS 21/22, 2 SWS, Language: German</td>
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Open in study portal
Content

- Fundamentals of flows and heat transfer
- Dimensionless parameters of thermal fluid dynamics
- Laminar and turbulent thermal boundary layer equations
- 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.

Organizational issues

Die Veranstaltung wird nur online gehalten, falls durch Corona Einschränkungen vorgegeben werden.

Literature

10.445 Course: Thin Film and Small-scale Mechanical Behavior [T-MACH-105554]

**Responsible:**
Dr. Patric Gruber  
Prof. Dr. Christoph Kirchlechner  
Dr. Daniel Weygand

**Organisation:**
KIT Department of Mechanical Engineering

**Part of:**
M-MACH-102649 - Major Field: Advanced Materials Modelling

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**Competence Certificate**
oral exam 30 minutes

**Prerequisites**
none

**Recommendation**
preliminary knowledge in materials science, physics and mathematics

**Below you will find excerpts from events related to this course:**

**Thin film and small-scale mechanical behavior**

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**Content**

1. Introduction: Application and properties of micro- and nanosystems; Overview on size effects
2. Fundamentals: Dislocation plasticity (definition of a dislocation; dislocation density, mobility, dislocation sources, statistical aspects incl. SSDs and GNDs).
4. Interface plasticity: Compatibility, slip transfer mechanisms, expected size effects.
5. Modelling of mechanisms causing size effects in crystals and at grain boundaries, e.g. dislocation dynamics.
7. Nanocrystalline materials: Synthesis, outstanding mechanical properties

The students know and understand size and scaling effects in micro- and nanosystems based on the fundamental microstructure mechanisms at play. They can describe the mechanical behavior of nano- and microstructured materials and analyze and explain the origin for the differences compared to classical material behavior. They are able to explain suitable processing routes, experimental characterization techniques and adequate modelling schemes for nano- and microstructured materials.

**regular attendance:** 22,5 hours  
**self-study:** 97,5 hours  
**oral exam ca. 30 minutes**
Organizational issues
Die Vorlesung wird unabhängig von den zuvor angekündigten Vorlesungsterminen angeboten. Dazu werden die Vorlesungsfolien mit Erklärungen und Tafelaufzrieben auf ILIAS bereitgestellt. Weitere Informationen zur Interaktion werden ebenfalls über ILIAS bekanntgegeben. Bei Fragen wenden Sie sich bitte jederzeit an patric.gruber@kit.edu.
Der Kursbeitritt in ILIAS erfolgt selbstständig.

Literature
2. L.B. Freund and S. Suresh: „Thin Film Materials
10.446 Course: Tires and Wheel Development for Passenger Cars [T-MACH-102207]

**Responsible:** Hon.-Prof. Dr. Günter Leister

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102607 - Major Field: Vehicle Technology

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**Events**

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**Legend:** Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

**Prerequisites**

none

Below you will find excerpts from events related to this course:

**Tires and Wheel Development for Passenger Cars**

2114845, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Content**

1. The role of the tires and wheels in a vehicle
2. Geometrie of Wheel and tire, Package, load capacity and endurance, Book of requirement
3. Mobility strategy, Minispare, runflat systems and repair kit.
4. Project management: Costs, weight, planning, documentation
5. Tire testing and tire properties
6. Wheel technology including Design and manufacturing methods, Wheeltesting
7. Tire pressure: Indirect and direct measuring systems
8. Tire testing subjective and objective

**Learning Objectives:**

The students are informed about the interactions of tires, wheels and chassis. They have an overview of the processes regarding the tire and wheel development. They have knowledge of the physical relationships.

**Organizational issues**

Voraussichtliche Termine, nähere Informationen und eventuelle Terminänderungen: siehe Institutshomepage.

**Literature**

Manuskript zur Vorlesung
Manuscript to the lecture
### 10.447 Course: Tractors [T-MACH-105423]

**Responsible:** Simon Becker  
Prof. Dr.-Ing. Marcus Geimer  
Hon.-Prof. Dr. Martin Kremmer  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102630 - Major Field: Mobile Machines

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗓 On-Site, ✗ Cancelled

**Competence Certificate**  
The assessment consists of a written exam taking place in the recess period (90 min).

**Prerequisites**  
one

**Recommendation**  
Basic knowledge in mechanical engineering.
Annotation

Learning Outcomes
After completion of the course the Students know:

- important problems in agritechnological developments
- Customer requirements and their implementation in tractors
- Tractor technology in width and depth

Content
Tractors are one of the most underestimated vehicles in regard to performance and technics. Almost none vehicle is as multifunctional and fulfilled with high-tech as a tractor. Automatic guidance, special chassis suspension or special concepts of power trains are one of the topics where tractors are in leading position in technologies.

During the lecture an overview about the design and construction and application area is given. A close look will be taken on the historical background, legal requirements, ways of development, agricultural organizations and the process of development itself.

In detail the following topics will be dealt with:

- agricultural organization / legal requirements
- history of tractors
- tractor engineering
- tractor mechanics
- chassis suspension
- combustion engine
- transmission
- interfaces
- hydraulics
- wheels and tyres
- cabin
- electrics and electronics

Literature

- K.T. Renius: Traktoren - Technik und ihre Anwendung; DLG Verlag (Frankfurt), 1985
- E. Schilling: Landmaschinen - Lehr- und Handbuch für den Landmaschinenbau; Schilling-Verlag (Köln), 1960

Below you will find excerpts from events related to this course:
Content
Tractors are one of the most underestimated vehicles in regard to performance and technics. Almost none vehicle is as multifunctional and fulfilled 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.

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- history of tractors
- tractor engineering
- tractor mechanics
- chassis suspension
- combustion engine
- transmission
- interfaces
- hydraulics
- wheels and tyres
- cabin
- electrics and electronics

basic knowledge in mechanical engineering

- regular attendance: 21 hours
- self-study: 92 hours

Organizational issues
Ort/Zeit siehe Institutshomepage

Literature

- K. T. Renius: Traktoren - Technik und ihre Anwendung; DLG Verlag (Frankfurt), 1985
- E. Schilling: Landmaschinen - Lehr- und Handbuch für den Landmaschinenbau; Schilling-Verlag (Köln), 1960
10.448 Course: Tribology [T-MACH-105531]

**Responsible:** Prof. Dr. Martin Dienwiebel  
Prof. Dr.-Ing. Matthias Scherge

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102599 - Major Field: Powertrain Systems  
M-MACH-102637 - Major Field: Tribology  
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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**Legend:** 🚀 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**
oral examination (ca. 40 min)
no tools or reference materials

**Prerequisites**
admission to the exam only with successful completion of the exercises [T-MACH-109303]

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-109303 - Exercises - Tribology must have been passed.

**Recommendation**
preliminary knowledge in mathematics, mechanics and materials science

Below you will find excerpts from events related to this course:
Content

- Chapter 1: Friction
  adhesion, geometrical and real area of contact, Friction experiments, friction powder, tribological stressing, environmental influences, tribological age, contact models, Simulation of contacts, roughness.
- Chapter 2: Wear
  plastic deformation at the asperity level, dissipation modes, mechanical mixing, Dynamics of the third body, running-in, running-in dynamics, shear stress.
- Chapter 3: Lubrication
  base oils, Striebeck plot, lubrication regimes (HD, EHD, mixed lubrication), additives, oil characterization, solid lubrication.
- Chapter 4: Measurement Techniques
  friction measurement, tribometer, dissipated frictional power, conventional wear measurement, continuous wear measurement (RNT)
- Chapter 5: Roughness
  profilometry, surface roughness parameters, evaluation length and filters, bearing ratio curve, measurement error
- Chapter 6: Accompanying Analysis
  multi-scale topography measurement, chemical surface analysis, structural analysis, mechanical analysis

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

The student can

- describe the fundamental friction and wear mechanisms, which occur in tribologically stressed systems
- evaluate the friction and wear behavior of tribological systems
- explain the effects of lubricants and their most important additives
- identify suitable approaches to optimize tribological systems
- explain the most important experimental methods for the measurement of friction and wear, and is able to use them for the characterisation of tribo pairs
- choose suitable methods for the evaluation of roughness and topography from the nm-scale to the mm-scale and is able to interpret the determined values in respect to their effect on the tribological behavior
- describe the most important surface-analytical methods and their physical principles for the characterization of tribologically stressed sliding surfaces

preliminary knowledge in mathematics, mechanics and materials science recommended

regular attendance: 45 hours
self-study: 195 hours
oral examination (ca. 40 min)
no tools or reference materials
admission to the exam only with successful completion of the exercises

Literature

10.449 Course: Turbine and Compressor Design [T-MACH-105365]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102610 - Major Field: Power Plant Technology
- M-MACH-102627 - Major Field: Energy Converting Engines
- M-MACH-102636 - Major Field: Thermal Turbomachines

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Exams

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<td>Turbine and Compressor Design</td>
<td>Bauer, Schulz</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

Competence Certificate
oral exam, duration: 20 min.

Prerequisites
Exams Thermal Turbomachinery I & II successfully passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105363 - Thermal Turbomachines I must have been passed.
2. The course T-MACH-105364 - Thermal Turbomachines II must have been passed.

Below you will find excerpts from events related to this course:

Turbine and compressor Design
2169462, WS 21/22, 2 SWS, Language: German, Open in study portal
Lecture (V) On-Site
Content
The lecture is intended to expand the knowledge from Thermal Turbomachines I+II.
Thermal Turbomaschines, general overview

Design of a turbomachine: Criteria and development

Radial machines

Transonic compressors

Combustion chambers

Multi-spool installations

The students have the ability to:

- describe special types of components, such as e.g. radial machines and transonic compressors
- explain and evaluate the operation of components and machines
- interpret and apply the physical principles
- design individual components in a practical approach

regular attendance: 21 h
self-study: 42 h

Exam:
oral
Duration: approximately 30 minutes

no tools or reference materials may be used during the exam

Organizational issues
Vorlesung findet in Präsenz statt, sofern es die COVID-Inzidenzwerte zulassen.

Literature

10.450 Course: Turbo Charging of Internal Combustion Engines [T-MACH-111591]

**Responsible:** Dr.-Ing. Johannes Kech
Dr.-Ing. Heiko Kubach

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102627 - Major Field: Energy Converting Engines
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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**Events**

| WT 21/22 | 2134153 | Boosting of Combustion Engines | 2 SWS | Kech |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**
oral exam, appr. 20 min

**Prerequisites**
none
10.451 Course: Turbo Jet Engines [T-MACH-105366]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102627 - Major Field: Energy Converting Engines  
- M-MACH-102636 - Major Field: Thermal Turbomachines

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**Events**

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**Competence Certificate**  
oral exam, duration: 20 min.

**Prerequisites**  
none

Below you will find excerpts from events related to this course:

**Turbo Jet Engines**  
2170478, SS 2021, 2 SWS, Language: German, [Open in study portal]

**Lecture (V)**  
Blended (On-Site/Online)

**Content**

- Introduction to jet engines and their components
- Demands on engines and propulsive efficiency
- Thermodynamic and gas dynamic fundamentals and design calculations
- Components of air breathing engines
- Jet engine design and development process
- Engine and component design
- Current developments in the jet engines industry

The students have the ability to:

- compare the design concepts of modern jet engines
- analyse the operation of modern jet engines
- apply the thermodynamic and fluidmechanic basics of jet engines
- choose the main components intake, compressor, combustor, turbine and thrust nozzle based on given criteria
- comment on different methods for the reduction of pollutant emissions, noise and fuel consumption

regular attendance: 21 h  
self-study: 42 h

**Exam:**  
oral  
Duration: approximately 30 minutes

no tools or reference materials may be used during the exam
Literature
Hagen, H.: Fluggasturbinen und ihre Leistungen, G. Braun Verlag, 1982
Hünnecke, K.: Flugtriebwerke, ihre Technik und Funktion, Motorbuch Verlag, 1993
**Course: Tutorial Continuum Mechanics of Solids and Fluids [T-MACH-110333]**

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke  
Prof. Dr.-Ing. Bettina Frohnapfel

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102628 - Major Field: Lightweight Construction  
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

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<td><strong>Course:</strong> Tutorial Continuum mechanics of solids and fluids</td>
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Dyck, Karl, Böhlke

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**

Successfully passing the Tutorial is a prerequisite for taking part in the exam "Continuum Mechanics of Solids and Fluids" (T-MACH-110377).

For students of Mechanical Engineering (BSc) that have chosen the Major Field "Continuum Mechanics" and for students of Material Science and Material Technology (BSc) the prerequisites consist of successfully solving the written homework sheets as well as the computational homework sheets during the associated computer tutorials.

For students of Mechanical Engineering that have chosen a different Major Field of study the prerequisites consist of successfully solving only the written homework sheets.

**Prerequisites**

None

**Annotation**

Due to capacity reasons it is possible that not all students of this course can be admitted to the computer tutorials. Students of the bachelor's degree program in mechanical engineering who have chosen the Major Field Continuum Mechanics (SP-Nr 13) and students of the bachelor's degree program in material science and material technology will be admitted to the computer tutorials in any case.

If additional places are available in the computer tutorials for this course, these will be allocated according to the BSc average grade.

**Below you will find excerpts from events related to this course:**

**Tutorial Continuum mechanics of solids and fluids**

2161253, WS 21/22, 1 SWS, Language: German, [Open in study portal](#)

<table>
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</table>

**Content**

Please refer to the lecture "Continuum mechanics of solids and fluids".

**Literature**

Siehe Vorlesung " Kontinuumsmechanik der Festkörper und Fluide ".

Please refer to the lecture "Continuum mechanics of solids and fluids".

---

Master Program Mechanical Engineering (M.Sc.), Date: 15/09/2021  
Module Handbook, valid from Winter Term 2021/2022
### 10.453 Course: Tutorial Global Production [T-MACH-110981]

**Responsible:** Prof. Dr.-Ing. Gisela Lanza  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:**  
M-MACH-102618 - Major Field: Production Technology  
M-MACH-102629 - Major Field: Logistics and Material Flow Theory

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#### Events

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#### Exams

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**  
Alternative achievement (ungraded). Successful completion of the case studies required. Further information will be announced in the course Global Production.

**Below you will find excerpts from events related to this course:**

**Tutorial Global Production**  
2149611, WS 21/22, 1 SWS, Language: German, [Open in study portal](#)  
Practice (Ü) Blended (On-Site/Online)
Content
The exercise serves as a supplement to the lecture Global Production and deals with the practical implementation of the management of global production networks of manufacturing companies. The contents conveyed in the lecture are put into practice in the exercise and supplemented by lectures from industry and research. The exercise initially builds on a basic understanding of the influencing factors and challenges of global production. Common methods and procedures for planning, designing and managing global production networks are applied in online case studies based on the restructuring of a fictitious company.

According to the lecture, the exercise is divided into three aspects: production strategy, network configuration and network management.

First of all, the exercise shows the connections between the company strategy and the production strategy and highlights the tasks necessary to define a production strategy. Subsequently, in the context of the design of global production networks, methods for site selection, site-specific adaptation of product design and production technology as well as for the establishment of a new production site and the adaptation of existing production networks to changing conditions are taught. With regard to the management of global production networks, the exercise primarily addresses the topic of procurement and supplier management in greater depth.

The topics in detail are:

- Production strategies for global production Networks
- From corporate strategy to production strategy
- Tasks of the production strategy (product portfolio management, recycling management, vertical integration planning, production-related research and development)
- Design of global production Networks
- Ideal-typical network structures
- Planning process for designing the network structure
- Adaptation of the network structure
- Choice of Location
- Production adjustment to suit the Location
- Management of global production Networks
- Coordination in global production Networks
- Procurement process

Learning Outcomes
The students …

- are able to apply defined procedures for site selection and evaluate a site decision with the help of different Methods.
- are capable of selecting adequate design options for site-specific production and product design on a case-specific basis.
- can explain the central elements of the planning process when setting up a new production site.
- are capable of applying the methods for the design and layout of global production networks to individual Company problems.
- are able to show the challenges and potentials of the corporate divisions sales, procurement and research and development on a global level.

Workload:
e-Learning: ~ 20 h
regular attendance: ~ 10 h
self-study: covered in the course of the lecture.

Organizational issues
Start: 05.11.2021
Übungstermine alle zwei Wochen freitags 16:00 Uhr - 17:30 Uhr.
Lectures every other week on Fridays, 16:00 h - 17:30 h.
Course: Tutorial Introduction to the Finite Element Method [T-MACH-110330]

10.454 Course: Tutorial Introduction to the Finite Element Method [T-MACH-110330]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Dr.-Ing. Tom-Alexander Langhoff

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102628 - Major Field: Lightweight Construction

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<td>pass/fail</td>
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Events

| ST 2021 | 2162257 | Tutorial Introduction to the Finite Element Method | 1 SWS | Practice / Online | Dyck, Langhoff, Böhlke |

Exams

| ST 2021 | 76-T-MACH-110330 | Tutorial Introduction to the Finite Element Method | Böhlke, Langhoff |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate

Successful participation in this course allows for registration to the Exam "Introduction to the Finite Element Method" (see 76-T-MACH-105320)

For students of Mechanical Engineering (BSc) that have chosen the Major Field "Continuum Mechanics" the prerequisites consist of successfully solving the written homework sheets as well as the computational homework sheets during the associated computer tutorials.

For students of Mechanical Engineering that have chosen a different Major Field and for students from different fields of study the prerequisites consist of successfully solving only the written homework sheets.

Annotation

Knowledge of the contents of the courses "Continuum Mechanics of Solids and Fluids" and "Mathematical Methods of Continuum Mechanics" as well as the corresponding tutorials are expected.

Due to capacity reasons it is possible that not all students of this course can be admitted to the computer tutorials. Students of the bachelor's degree program in mechanical engineering who have chosen the Major Field Continuum Mechanics (SP-Nr 13) will be admitted to the computer tutorials in any case.

If additional places are available in the computer tutorials for this course, these will be allocated according to the BSc average grade.

Below you will find excerpts from events related to this course:

Tutorial Introduction to the Finite Element Method
2162257, SS 2021, 1 SWS, Language: German, Open in study portal

Content
See lecture "Introduction to the Finite Element Method"

Literature
siehe Vorlesung "Einführung in die Finite-Elemente-Methode"
10.455 Course: Tutorial Mathematical Methods in Continuum Mechanics [T-MACH-110376]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102594 - Mathematical Methods
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102742 - Fundamentals and Methods of Production Technology
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
- M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

<table>
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<th>Recurrence</th>
<th>Expansion</th>
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<td>pass/fail</td>
<td>Each winter term</td>
<td>1 terms</td>
<td>2</td>
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**Events**

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<th>Recurrence</th>
<th>Expansion</th>
<th>Version</th>
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<tr>
<td>WT 21/22</td>
<td>Tutorial Mathematical Methods in Continuum Mechanics</td>
<td>2 SWS</td>
<td>Practice / 🗻</td>
<td>1 terms</td>
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</table>

**Competence Certificate**

Successfully solving the homework sheets. Details are announced in the first lecture.

**Prerequisites**

None

**Below you will find excerpts from events related to this course:**

<table>
<thead>
<tr>
<th>V</th>
<th>Tutorial Mathematical Methods in Continuum Mechanics</th>
<th>2161255, WS 21/22, 2 SWS, Language: German, Open in study portal</th>
<th>Practice (Ü)</th>
<th>Blended (On-Site/Online)</th>
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</thead>
</table>

**Content**

See "Mathematical Methods in Continuum Mechanics"

**Literature**

Siehe "Mathematische Methoden der Kontinuumsmechanik"
10.456 Course: Tutorial Mathematical Methods in Micromechanics [T-MACH-110379]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102594 - Mathematical Methods
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

<table>
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<td>Each summer term</td>
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</table>

Exams
ST 2021 76-T-MACH-110400 Tutorial Mathematical Methods in Micromechanics Böhlke

Competence Certificate
Successfully solving the homework sheets. Details are given in the first lecture.

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction

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<td>Each summer term</td>
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<tr>
<td>Version</td>
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</table>

Events

| ST 2021 | 2162281 | Tutorial Mathematical Methods in Micromechanics | 1 SWS | Practice / 🧩 | Karl, Krause, Böhlke |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate
Successfully solving the homework sheets. Details are given in the first lecture.

Prerequisites
none

Below you will find excerpts from events related to this course:

Tutorial Mathematical Methods in Micromechanics
2162281, SS 2021, 1 SWS, Language: German, Open in study portal

Practice (Ü)
Blended (On-Site/Online)

Content
see lecture "Mathematical Methods in Micromechanics"
10.458 Course: Tutorial Nonlinear Continuum Mechanics [T-MACH-111027]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke

**Organisation:**

<table>
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<tr>
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<th>M-MACH-102597 - Compulsory Elective Module Mechanical Engineering</th>
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<td>M-MACH-102646 - Major Field: Applied Mechanics</td>
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<tr>
<td>ST 2021</td>
</tr>
<tr>
<td>76-T-MACH-111027</td>
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</table>

**Competence Certificate**

Written homework problems

Successful participation in this course allows for registration to the Exam "Nonlinear Continuum Mechanics" (see 76-T-MACH-111026)

**Prerequisites**

none
Course: Two-Phase Flow and Heat Transfer [T-MACH-105406]

Responsible: Hon.-Prof. Dr. Thomas Schulenberg
Dr. Martin Wörner

Organisation: KIT Department of Chemical and Process Engineering
KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102608 - Major Field: Nuclear Energy
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102634 - Major Field: Fluid Mechanic
M-MACH-102643 - Major Field: Fusion Technology

**Type**
Oral examination

**Credits**
4

**Grading scale**
Grade to a third

**Version**
1

**Events**

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<th>Version</th>
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**Exams**

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<td>76-T-MACH-105406</td>
<td>Lecture / 🖥️</td>
<td>1</td>
</tr>
</tbody>
</table>

**Competence Certificate**
oral exam, duration: approximately 30 minutes
no tools or reference materials may be used during the exam

**Prerequisites**
none

Below you will find excerpts from events related to this course:

**Two-Phase Flow and Heat Transfer**

2169470, WS 21/22, 2 SWS, Language: German/English, [Open in study portal]

**Content**
The students can describe two-phase flows with heat transfer as phenomena occurring in steam generators and condensers (e.g. in power stations or refrigerators). They can distinguish different flow regimes and transitions and apply two-phase flow models. The students are qualified to explain the characteristics of different flow examples (e.g. pressure drop of two phase flows, pool boiling, forced convective boiling, condensation) and can analyse two-phase flow instabilities.

- Examples for technical applications
- Definitions and averaging of two-phase flows
- Flow regimes and transitions
- Two-phase models
- Pressure drop of two phase flows
- Pool boiling
- Forced convective boiling
- Condensation
- Two-phase flow instabilities

**Literature**
Vorlesungsskript
10.460 Course: Vacuum and Tritium Technology in Nuclear Fusion [T-MACH-108784]

**Responsible:** Dr. Christian Day  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102643 - Major Field: Fusion Technology

<table>
<thead>
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<td>Each summer term</td>
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</table>

**Events**

| ST 2021 | 2190499 | Vacuum and Tritium Technology in Nuclear Fusion | 2 SWS | Day, Größle |

**Exams**

| ST 2021 | 76-T-MACH-108784 | Vacuum and Tritium Technology in Nuclear Fusion | Day, Bornschein |

**Competence Certificate**
oral examination, approx. 20 Minutes, any time in the year

**Prerequisites**
none

**Recommendation**
Knowledge in ‘Fusion Technology A’

Below you will find excerpts from events related to this course:

**Vacuum and Tritium Technology in Nuclear Fusion**  
2190499, SS 2021, 2 SWS, Language: German/English, [Open in study portal](#)

**Content**
Introduction  
Tritium Handling  
Tritium Plant Technologies  
Tritium and Breeding  
Fundamentals of Vacuum Science and Technology  
Fusion Vacuum systems  
Matter Injection into the Plasma Chamber  
Fuel Cycle of ITER and DEMO

The students have acquired the necessary understanding in order to design and size facilities for tritium operation. They understand the process steps in the tritium plant of a fusion reactor for tritium removal and tritium recovery from tritiated exhaust gas. Furthermore, the students have understood the fundamentals of vacuum physics and are able to design and choose vacuum pumps properly.

recommended is Knowledge in "Fusion Technology A"  
oral exam of about 20 min

**Organizational issues**
Anmeldung bis 20. April via E-Mail an: christian.day@kit.edu

Die Vorlesung findet an 4 Tagen in der Zeit von 08:00-17:15 Uhr am Campus Nord statt. Der Raum wird noch bekanntgegeben. Termine werden mit angemeldeten Teilnehmern Ende April für Juni vereinbart.
10.461 Course: Vehicle Comfort and Acoustics I [T-MACH-105154]

**Responsible:** Prof. Dr. Frank Gauterin  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics  
- M-MACH-102607 - Major Field: Vehicle Technology  
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains  
- M-MACH-104443 - Major Field: Vibration Theory

<table>
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<th>Recurrence</th>
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<td>Grade to a third</td>
<td>Each winter term</td>
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**Events**

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<td>ST 2021</td>
<td>2114856</td>
<td>Vehicle Ride Comfort &amp; Acoustics I</td>
<td>2</td>
<td>Lecture / Online</td>
<td>Gauterin</td>
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<td>2113806</td>
<td>Vehicle Comfort and Acoustics I</td>
<td>2</td>
<td>Lecture / Online</td>
<td>Gauterin</td>
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**Exams**

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<td>Vehicle Comfort and Acoustics I</td>
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<td>Lecture / Online</td>
<td>Gauterin</td>
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</table>

**Competence Certificate**

**Oral Examination**

Duration: 30 up to 40 minutes

Auxiliary means: none

**Prerequisites**

Can not be combined with lecture T-MACH-102206

**Below you will find excerpts from events related to this course:**

**Vehicle Ride Comfort & Acoustics I**  
2114856, SS 2021, 2 SWS, Language: English, Open in study portal

**Content**

1. Perception of noise and vibrations

3. Fundamentals of acoustics and vibrations

3. Tools and methods for measurement, computing, simulation and analysis of noise and vibrations

4. The relevance of tire and chassis for the acoustic and mechanical driving comfort: phenomena, influencing parameters, types of construction, optimization of components and systems, conflict of goals, methods of development

An excursion will give insights in the development practice of a car manufacturer or a system supplier.

**Learning Objectives:**

The students know what noises and vibrations mean, how they are generated, and how they are perceived by human beings. They have knowledge about the requirements given by users and the public. They know which components of the vehicle are participating in which way on noise and vibration phenomenon and how they could be improved. They are ready to apply different tools and methods to analyze relations and to judge them. They are able to develop the chassis regarding driving comfort and acoustic under consideration of goal conflicts.
Organizational issues
Kann nicht mit der Veranstaltung [2113806] kombiniert werden.
Can not be combined with lecture [2113806]
Genaue Termine entnehmen Sie bitte der Institushomepage.
Scheduled dates:
see homepage of the institute.

Literature
2. Russel C. Hibbeler, Technische Mechanik 3, Dynamik, Pearson Studium, München, 2006

Das Skript wird zu jeder Vorlesung zur Verfügung gestellt

Content
1. Perception of noise and vibrations
2. Fundamentals of acoustics and vibrations
3. Tools and methods for measurement, computing, simulation and analysis of noise and vibrations
4. The relevance of tire and chasis for the acoustic and mechanical driving comfort: phenomena, influencing parameters, types of construction, optimization of components and systems, conflict of goals, methods of development

An excursion will give insights in the development practice of a car manufacturer or a system supplier.

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The students know what noises and vibrations mean, how they are generated, and how they are perceived by human beings. They have knowledge about the requirements given by users and the public. They know which components of the vehicle are participating in which way on noise and vibration phenomenon and how they could be improved. They are ready to apply different tools and methods to analyze relations and to judge them. They are able to develop the chasis regarding driving comfort and acoustic under consideration of goal conflicts.

Organizational issues
Kann nicht mit der Veranstaltung [2114856] kombiniert werden.
Can not be combined with lecture [2114856]

Literature
2. Russel C. Hibbeler, Technische Mechanik 3, Dynamik, Pearson Studium, München, 2006

Das Skript wird zu jeder Vorlesung zur Verfügung gestellt
10.462 Course: Vehicle Comfort and Acoustics II [T-MACH-105155]

Responsible: Prof. Dr. Frank Gauterin
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-102650 - Major Field: Combustion Engines Based Powertrains
- M-MACH-104443 - Major Field: Vibration Theory

Events
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<td>Each summer term</td>
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Exams
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<tr>
<td>ST 2021 2114825 Vehicle Comfort and Acoustics II 2 SWS Lecture / Online Gauterin</td>
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<td>ST 2021 2114857 Vehicle Ride Comfort &amp; Acoustics II 2 SWS Lecture / Online Gauterin</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Oral Examination
Duration: 30 up to 40 minutes
Auxiliary means: none

Prerequisites
Can not be combined with lecture T-MACH-102205

Below you will find excerpts from events related to this course:

Vehicle Comfort and Acoustics II
2114825, SS 2021, 2 SWS, Language: German, Open in study portal
Content
1. Summary of the fundamentals of acoustics and vibrations

2. The relevance of road surface, wheel imperfections, springs, dampers, brakes, bearings and bushings, suspensions, engines and drive train for the acoustic and mechanical driving comfort:
   - phenomena
   - influencing parameters
   - types of construction
   - optimization of components and systems
   - conflicts of goals
   - methods of development

3. Noise emission of motor vehicles
   - noise stress
   - sound sources and influencing parameters
   - legal restraints
   - optimization of components and systems
   - conflict of goals
   - methods of development

Learning Objectives:

Organizational issues
Kann nicht mit der Veranstaltung [2114857] kombiniert werden.
Can not be combined with lecture [2114857]

Literature
Das Skript wird zu jeder Vorlesung zur Verfügung gestellt.

Vehicle Ride Comfort & Acoustics II
2114857, SS 2021, 2 SWS, Language: English, Open in study portal
**Organizational issues**
Genaue Termine entnehmen Sie bitte der Institushomepage.
Kann nicht mit der Veranstaltung [2114825] kombiniert werden.

Scheduled dates:
see homepage of the institute.
Can not be combined with lecture [2114825].

**Literature**
Das Skript wird zu jeder Vorlesung zur Verfügung gestellt.
The script will be supplied in the lectures.
10.463 Course: Vehicle Ergonomics [T-MACH-108374]

**Responsible:** Prof. Dr.-Ing. Barbara Deml

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102600 - Major Field: Man - Technology - Organisation
- M-MACH-102605 - Major Field: Engineering Design
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
- M-MACH-102609 - Major Field: Cognitive Technical Systems
- M-MACH-102630 - Major Field: Mobile Machines

<table>
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<td>4</td>
<td>Grade to a third</td>
<td>Each summer term</td>
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**Competence Certificate**
written exam, 60 minutes

**Prerequisites**
none

**Responsible:** Prof. Dr.-Ing. Frank Henning

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102607 - Major Field: Vehicle Technology
- M-MACH-102628 - Major Field: Lightweight Construction
- M-MACH-102632 - Major Field: Polymer Engineering
- M-MACH-102641 - Major Field: Rail System Technology

**Type**
- Written examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each winter term

**Version**
- 1

**Exams**
- WT 21/22 76-T-MACH-105237 Vehicle Lightweight Design - Strategies, Concepts, Materials 2 SWS Lecture / 🧩 Henning

**Prerequisites**
- none

**Recommendation**
- none

Below you will find excerpts from events related to this course:

**Vehicle Lightweight design – Strategies, Concepts, Materials**
- 2113102, WS 21/22, 2 SWS, Language: German, Open in study portal
- Lecture (V) Blended (On-Site/Online)

**Content**
- Strategies in lightweight design
- Shape optimization, light weight materials, multi-materials and concepts for lightweight design
- Construction methods
- Differential, integral, sandwich, modular, bionic
- Body construction
- Shell, space frame, monocoque
- Metallic materials
- Steel, aluminium, magnesium, titan

**Aim of this lecture:**
- Students learn that lightweight design is a process of realizing a demanded function by using the smallest possible mass. They understand lightweight construction as a complex optimization problem with multiple boundary conditions, involving competences from methods, materials and production.
- Students learn the established lightweight strategies and ways of construction. They know the metallic materials used in lightweight construction and understand the relation between material and vehicle body.

**Organizational issues**
- Die erste Vorlesung des Semesters findet am 22.10.2021 um 12:00 Uhr zunächst online über Zoom statt - Den Zugangslink und das entsprechende Passwort finden Sie im zugehörigen Ilias-Kurs. Über die weitere Handhabung der Vorlesung in Präsenz oder Online wird in Abstimmung mit den teilnehmenden Studierenden entschieden.
Literature
# 10.465 Course: Vehicle Mechatronics I [T-MACH-105156]

**Responsible:** Prof. Dr.-Ing. Dieter Ammon  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102598 - Major Field: Advanced Mechatronics  
M-MACH-102601 - Major Field: Automation Technology  
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics

<table>
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<td>Grade to a third</td>
<td>see Annotations</td>
<td>1</td>
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</table>

**Competence Certificate**  
Examinations are no longer offered.

**Prerequisites**  
none

**Annotation**  
The lecture was cancelled for WT 19/20.
10 COURSES
Course: Vibration Theory [T-MACH-105290]

**10.466 Course: Vibration Theory [T-MACH-105290]**

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin
Prof. Dr.-Ing. Wolfgang Seemann

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
- M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
- M-MACH-102598 - Major Field: Advanced Mechatronics
- M-MACH-102614 - Major Field: Mechatronics
- M-MACH-102636 - Major Field: Thermal Turbomachines
- M-MACH-102646 - Major Field: Applied Mechanics
- M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
- M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
- M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
- M-MACH-102742 - Fundamentals and Methods of Production Technology
- M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
- M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems
- M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics
- M-MACH-104443 - Major Field: Vibration Theory

<table>
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**Exams**

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**Competence Certificate**
written exam, 180 min.

**Prerequisites**
none

*Below you will find excerpts from events related to this course:*

**Vibration Theory**

2161212, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**

**Content**

Concept of vibration, superposition of vibration with equal and with different frequencies, complex frequency response.

Vibration of systems with one dof: Free undamped and damped vibration, forced vibration for harmonic, periodic and arbitrary excitation. Excitation of undamped vibration in resonance.


Vibration of systems with distributed parameters: Partial differential equations as equations of motion, wave propagation, d'Alembert's solution, Ansatz for separation of time and space, eigenvalue problem, infinite number of eigenvalues and eigenfunctions.

Introduction to rotor dynamics: Laval rotor in rigid and elastic bearings, inner damping, Laval rotor in anisotropic bearings, synchronous and asynchronous whirl, rotors with asymmetric shaft.
Literature
Klotter: Technische Schwingungslehre, Bd. 1 Teil A, Heidelberg, 1978
Hagedorn, Otterbein: Technische Schwingungslehre, Bd. 1 und Bd. 2, Berlin, 1987

Übungen zu Technische Schwingungslehre
2161213, WS 21/22, 2 SWS, Language: German, [Open in study portal]

Content
Exercises related to the lecture
10.467 Course: Virtual Engineering (Specific Topics) [T-MACH-105381]

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

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**Exams**

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<td>2 SWS</td>
<td>Lecture / 🖥</td>
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**Competence Certificate**
oral exam, 20 min.

**Prerequisites**
none

Below you will find excerpts from events related to this course:

**Virtual Engineering (Specific Topics)**
3122031, SS 2021, 2 SWS, Language: English, Open in study portal

**Lecture (V) Online**

**Content**

Students can

- explain the basics of virtual engineering and name exemplary modeling tools and assign them to the corresponding methods and processes
- Formulate validation questions in the product development process and name obvious solution methods
- explain the basics of systems engineering and establish the connection to the product development process
- explain individual methods of the digital factory and present the functions of the digital factory in the context of the product creation process
- explain the theoretical and technical basics of Virtual Reality technology and show the connection to Virtual Engineering

**Organizational issues**

Vorlesungszeiten siehe ILIAS / Lecture times see ILIAS

**Literature**

Lecture slides / Vorlesungsfolien
**10.468 Course: Virtual Engineering I [T-MACH-102123]**

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102613 - Major Field: Lifecycle Engineering

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**  
Written examination 90 min.

**Prerequisites**  
None

Below you will find excerpts from events related to this course:

**Virtual Engineering I**  
2121352, WS 21/22, 2 SWS, Language: English, Open in study portal  
Lecture (V)  
Blended (On-Site/Online)

**Content**  
The course includes:

- Conception of the product (system approaches, requirements, definitions, structure)
- Generation of domain-specific product data (CAD, ECAD, software, ...) and AI methods
- Validation of product properties and production processes through simulation
- Digital twin for optimization of products and processes using AI methods

After successful attendance of the course, students can:

- conceptualse complex systems with the methods of virtual engineering and continue the product development in different domains
- model the digital product with regard to planning, design, manufacturing, assembly and maintenance.
- use validation systems to validate product and production in an exemplary manner.
- Describe AI methods along the product creation process.

**Literature**  
Vorlesungsfolien / Lecture slides

**Exercises Virtual Engineering I**  
2121353, WS 21/22, 2 SWS, Language: English, Open in study portal  
Practice (Ü)  
Blended (On-Site/Online)

**Content**  
The theoretical Konzepts and contents of the lecture will be trained within practical relevance by basic functionalities of VE System solutions.
Organizational issues
Practice dates will probably be offered on different afternoons (14:00 - 17:15) in two-week intervals at the IMI in Kriegsstrasse 77 / Übungstermine werden voraussichtlich an unterschiedlichen Nachmittagen (14:00 - 17:15) in zweiwöchigem Rhythmus am IMI in der Kriegsstrasse 77 angeboten.

Literature
Exercise script / Übungsskript
10.469 Course: Virtual Engineering II [T-MACH-102124]

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
- M-MACH-102613 - Major Field: Lifecycle Engineering

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**Credits: 4**

**Grading scale:** Grade to a third

**Recurrence:** Each summer term

**Version:** 2

**Prerequisites:** None

**Exams**

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<td>Type</td>
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**Competence Certificate**

Written examination 90 min.

**Below you will find excerpts from events related to this course:**

**Virtual Engineering II**

2122378, SS 2021, 2/1 SWS, Language: English, [Open in study portal](#)

**Lecture / Practice (VÜ)**

Online

**Content**

The course includes:

- Fundamentals (Computer Graphics, VR, AR, MR)
- Hardware and Software Solutions
- Virtual Twin, Validation and application

After successful attendance of the course, students can:

- describe Virtual Reality concepts, as well as explaining and comparing the underlying technologies
- discuss the modeling and computer-internal picture of a VR scene and explain the operation of the pipeline to visualize the scene
- designate different systems to interact with a VR scene and assess the pros and cons of manipulation and tracking devices
- differentiate between static, dynamic and functional Virtual Twins
- describe applications and validation studies with Virtual Twins in the area of building and production

**Organizational issues**

Zusätzliche Übungszeiten (1 SWS) werden zu Vorlesungsbegin bekannt gegeben / Additional practice times (1 SWS) will be announced at the beginning of the lecture.

**Literature**

Vorlesungsfolien / Lecture slides
10.470 Course: Virtual Engineering Lab [T-MACH-106740]

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102613 - Major Field: Lifecycle Engineering

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**Legend:**  
🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Canceled

**Competence Certificate**  
Assessment of another type (graded), procedure see webpage.

Below you will find excerpts from events related to this course:

**Virtual Engineering Lab**  
2123350, SS 2021, 3 SWS, Language: German/English, Open in study portal

**Content**

- Introduction in Virtual Reality (hardware, software, applications)  
- Exercises in the task specific software systems  
- Autonomous project work in the area of Virtual Reality in small groups

**Organizational issues**  
Siehe Homepage zur Lehrveranstaltung

**Literature**

Keine / None

**Virtual Engineering Lab**  
2123350, WS 21/22, 3 SWS, Language: German/English, Open in study portal

**Content**

- Introduction in Virtual Reality (hardware, software, applications)  
- Exercises in the task specific software systems  
- Autonomous project work in the area of Virtual Reality in small groups

**Organizational issues**  
Siehe Homepage zur Lehrveranstaltung

**Literature**

Keine / None
10.471 Course: Virtual Reality Practical Course [T-MACH-102149]

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102601 - Major Field: Automation Technology  
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering  
M-MACH-102614 - Major Field: Mechatronics  
M-MACH-102633 - Major Field: Robotics

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**Events**

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**Competence Certificate**  
Assessment of another type (graded)

**Prerequisites**  
None

**Annotation**  
Number of participants is limited

Below you will find excerpts from events related to this course:

**Virtual Reality Practical Course**  
2123375, WS 21/22, 3 SWS, Language: German/English, [Open in study portal](#).

**Project (PRO)**  
Blended (On-Site/Online)

**Content**

- Introduction in Virtual Reality (hardware, software, applications)
- Exercises in the task specific software systems
- Autonomous project work in the area of Virtual Reality in small groups

**Organizational issues**  
Siehe Homepage zur Lehrveranstaltung

**Literature**  
Keine / None
**10.472 Course: Virtual Solution Methods and Processes [T-MACH-111285]**

**Responsible:** Dipl.-Ing. Thomas Maier  
Prof. Dr.-Ing. Jivka Ovtcharova  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-102613 - Major Field: Lifecycle Engineering

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗼 On-Site, ✗ Canceled

**Competence Certificate**
Graded examination performance of another type weighted according to: 30% project documentation, 30% colloquium and 40% successfully completed project task.

**Prerequisites**
None

**Recommendation**
None

Below you will find excerpts from events related to this course:

**Virtual Solution Methods and Processes**  
2121003, SS 2021, 4 SWS, Language: German/English, [Open in study portal](#)

**Project (PRO)**  
Blended (On-Site/Online)

**Content**
Requirements, SysML, Modelica, high performance computing, process modeling, Virtual Twin

Students can:

- Collect requirements for large technical systems (e.g.: Helmholtz large-scale device KATRIN).
- Describe physical systems across domains with the modeling language Modelica and simulate the systems behavior.
- Generate complex FE meshes for simulations of structural mechanics, electrodynamics or fluid mechanics.
- Perform advanced simulations on mainframe computers and prepare and explain results in a self-explanatory manner.
- Individually design a small project and carry it out independently.

**Organizational issues**
Siehe ILIAS und Homepage zur Lehrveranstaltung

**Virtual Solution Methods and Processes**  
2121003, WS 21/22, 4 SWS, Language: German/English, [Open in study portal](#)

**Project (PRO)**  
Blended (On-Site/Online)

**Content**
Requirements, SysML, Modelica, high performance computing, process modeling, Virtual Twin

Students can:

- Collect requirements for large technical systems (e.g.: Helmholtz large-scale device KATRIN).
- Describe physical systems across domains with the modeling language Modelica and simulate the systems behavior.
- Generate complex FE meshes for simulations of structural mechanics, electrodynamics or fluid mechanics.
- Perform advanced simulations on mainframe computers and prepare and explain results in a self-explanatory manner.
- Individually design a small project and carry it out independently.
Organizational issues
Siehe Ilias und Homepage zur Lehrveranstaltung
## Course: Virtual Training Factory 4.X [T-MACH-106741]

### Responsible
Prof. Dr.-Ing. Jivka Ovtcharova

### Organisation
KIT Department of Mechanical Engineering

### Part of
M-MACH-102613 - Major Field: Lifecycle Engineering

### Type
Examination of another type

### Credits
4

### Grading scale
Grade to a third

### Recurrence
Each term

### Version
1

### Events

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### Exams

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### Competence Certificate
Assessment of another type (graded), procedure see webpage.

### Below you will find excerpts from events related to this course:

**Virtual training factory 4.X**

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**Content**
In interdisciplinary teams, the creation of a product is implemented in the style of a start-up. The event is carried out across universities in cooperation with the HsKA.

**Organizational issues**
Siehe ILIAS

**Literature**
Keine / None

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**Virtual training factory 4.X**

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**Content**
In interdisciplinary teams, the creation of a product is implemented in the style of a start-up. The event is carried out across universities in cooperation with the HsKA.

**Organizational issues**
Siehe ILIAS zur Lehrveranstaltung

**Literature**
Keine / None
10.474 Course: Vortex Dynamics [T-MACH-105784]

**Responsible:** Dr. Jochen Kriegseis  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102627 - Major Field: Energy Converting Engines  
M-MACH-102634 - Major Field: Fluid Mechanic  
M-MACH-102636 - Major Field: Thermal Turbomachines

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**Events**

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</table>

**Legend:** 🕵️ Online, 🕵️ Blended (On-Site/Online), 🗿 On-Site, ✗ Cancelled

**Competence Certificate**

oral exam - 30 minutes

**Prerequisites**

none

**Below you will find excerpts from events related to this course:**

**Vortex Dynamics**

2153438, WS 21/22, 2 SWS, Language: German, Open in study portal

**Lecture (V)**  
Blended (On-Site/Online)

**Content**

The students can describe the physical basics and the mathematical description of vortex flows and are able to explain characteristic phenomena of vortex flows (e.g. vorticity, circulation and dissipation). They are qualified to analyze two- and three-dimensional vortex flows in steady and time-dependent form with respect to their structure and time-behaviour.

- 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 vortex identification approaches

**Literature**

10 Course: Warehousing and Distribution Systems [T-MACH-105174]

**Responsible:** Prof. Dr.-Ing. Kai Furmans

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102618 - Major Field: Production Technology
- M-MACH-102625 - Major Field: Information Technology of Logistic Systems
- M-MACH-102629 - Major Field: Logistics and Material Flow Theory
- M-MACH-102640 - Major Field: Technical Logistics

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**Exams**

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<td>2 SWS</td>
<td>Grade to a third</td>
<td>Each summer term</td>
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**Competence Certificate**
The success control takes place in form of a written examination (60 min) during the semester break (according to §4(2), 1 SPO). If the number of participants is low, an oral examination (according to §4 (2), 2 SPO) may also be offered.

**Prerequisites**

none

Below you will find excerpts from events related to this course:

**Warehousing and distribution systems**

2118097, SS 2021, 2 SWS, Language: German, Open in study portal

**Literature**

ARNOLD, Dieter, FURMANS, Kai (2005)
Materialfluss in Logistiksystemen, 5. Auflage, Berlin: Springer-Verlag

ARNOLD, Dieter (Hrsg.) et al. (2008)
Handbuch Logistik, 3. Auflage, Berlin: Springer-Verlag

Warehouse Science

GUDEHUS, Timm (2005)
Logistik, 3. Auflage, Berlin: Springer-Verlag

FRAZELLE, Edward (2002)
World-class warehousing and material handling, McGraw-Hill

MARTIN, Heinrich (1999)
Praxiswissen Materialflußplanung: Transport, Hanshaben, Lagern, Kommissionieren, Braunschweig, Wiesbaden: Vieweg

WISSE, 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
10.476 Course: Wave Propagation [T-MACH-105443]

**Responsible:** Prof. Dr.-Ing. Wolfgang Seemann  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
- M-MACH-102598 - Major Field: Advanced Mechatronics  
- M-MACH-102601 - Major Field: Automation Technology  
- M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics  
- M-MACH-104443 - Major Field: Vibration Theory

<table>
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</table>

**Competence Certificate**

oral exam, 30 min.

Below you will find excerpts from events related to this course:

**Wave Propagation**

2161219, WS 21/22, 2 SWS, Language: German, Open in study portal

**Content**

The course gives an introduction into wave propagation phenomena. This contains both one-dimensional continua (beams, rods, strings) as well as two- and three-dimensional continua. Initial condition problems are treated. Fundamental effects like velocity, group velocity or dispersion are explained. Wave propagation is used to show the limits of structural models like beams. In addition surface waves and acoustic waves are covered.

**Literature**

10.477 Course: Welding Technology [T-MACH-105170]

**Responsible:** Dr. Majid Farajian  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102611 - Major Field: Materials Science and Engineering  
M-MACH-102618 - Major Field: Production Technology

<table>
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**Events**

| WT 21/22 | 2173571 | Welding Technology | 2 SWS | Block / 🖥 | Farajian |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Oral exam, about 20 minutes

**Prerequisites**

none

**Recommendation**

Basics of material science (iron- and non-iron alloys), materials, processes and production, design.

All the relevant books of the German Welding Institute (DVS: Deutscher Verband für Schweißen und verwandte Verfahren) in the field of welding and joining is recommended.

*Below you will find excerpts from events related to this course:*

<table>
<thead>
<tr>
<th>Welding Technology</th>
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<tbody>
<tr>
<td>2173571, WS 21/22, 2 SWS, Language: German, Open in study portal</td>
</tr>
</tbody>
</table>

Block (B) Online
Content definition, application and differentiation: welding, welding processes, alternative connecting technologies. history of welding technology sources of energy for welding processes Survey: Fusion welding, pressure welding, weld seam preparation/design welding positions weldability gas welding, thermal cutting, manual metal-arc welding submerged arc welding gas-shielded metal-arc welding, friction stir welding, laser beam and electron beam welding, other fusion and pressure welding processes static and cyclic behavior of welded joints, fatigue life improvement techniques learning objectives: The students have knowledge and understanding of the most important welding processes and its industrial application. They are able to recognize, understand and handle problems occurring during the application of different welding processes relating to design, material and production. They know the classification and the importance of welding technology within the scope of connecting processes (advantages/ disadvantages, alternatives). The students will understand the influence of weld quality on the performance and behavior of welded joints under static and cyclic load. How the fatigue life of welded joints could be increased, will be part of the course. requirements: basics of material science (iron- and non-iron alloys), of electrical engineering, of production processes. workload: The workload for the lecture Welding Technology is 120 h per semester and consists of the presence during the lecture (18 h) as well as preparation and rework time at home (102 h). exam: oral, ca. 20 minutes, no auxiliary material Organizational issues Blockveranstaltung im Januar und Februar. Zur Teilnahme an der Vorlesung ist eine Anmeldung beim Dozenten per E-Mail an Farajian@slv-duisburg.de erforderlich: Vorlesungstermine und Hörsaal werden den angemeldeten Teilnehmern Anfang des Jahres mitgeteilt. Literature Für ergänzende, vertiefende Studien gibt das Handbuch der Schweißtechnik von J. Ruge, Springer Verlag Berlin, mit seinen vier Bänden Band I: Werkstoffe Band II: Verfahren und Fertigung Band III: Konstruktive Gestaltung der Bauteile Band IV: Berechnung der Verbindungen einen umfassenden Überblick. Der Stoff der Vorlesung Schweißtechnik findet sich in den Bänden I und II. Einen kompakten Einblick in die Lichtbogenschweißverfahren bietet das Bändchen Nies: Lichtbogenschweißtechnik, Bibliothek der Technik Band 57, Verlag moderne Industrie AG und Co., Landsberg / Lech Im Übrigen sei auf die zahlreichen Fachbücher des DVS Verlages, Düsseldorf, zu allen Einzelgebieten der Fügetechnik verwiesen.
10.478 Course: Windpower [T-MACH-105234]

**Responsible:** Norbert Lewald  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102610 - Major Field: Power Plant Technology  
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology  
- M-MACH-102627 - Major Field: Energy Converting Engines  
- M-MACH-102648 - Major Field: Energy Technology for Buildings

<table>
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**Events**

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**Competence Certificate**

- written exam, 120 minutes

**Prerequisites**

- none

Below you will find excerpts from events related to this course:

Windpower  
2157381, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)
**10.479 Course: Workshop on Computer-based Flow Measurement Techniques [T-MACH-106707]**

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:**  
- M-MACH-102591 - Laboratory Course  
- M-MACH-102610 - Major Field: Power Plant Technology  
- M-MACH-102623 - Major Field: Fundamentals of Energy Technology  
- M-MACH-102636 - Major Field: Thermal Turbomachines  

<table>
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<td>3 SWS</td>
<td>Practical course /</td>
<td>Bauer, Mitarbeiter</td>
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<td>2171488</td>
<td>Workshop on computer-based flow measurement techniques</td>
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**Exams**

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**Legend:**  
- 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**  
Group colloquia for each topic  
Duration: approximately 10 minutes  
no tools or reference materials may be used  
**Prerequisites**  
none

Below you will find excerpts from events related to this course:

**Workshop on computer-based flow measurement techniques**  
2171488, SS 2021, 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 exercise

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

Workshop on computer-based flow measurement techniques

2171488, WS 21/22, 3 SWS, Language: German, Open in study portal
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.

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- Analog to digital conversion
- Program design and programming methods using LabView
- Data handling
- Bus systems
- Design of a computer aided data acquisition system for pressure, temperature and derived parameters
- frequency analysis

regular attendance: 52,5
self-study: 67,5

Lernziele:

Die Studenten können:

- die wesentlichen Grundlagen der rechnergestützen Messwerterfassung theoretisch beschreiben und praktisch anwenden
- nach jedem Lernabschnitt den vorgestellten Stoff anhand eines Beispiels am PC in die Praxis umsetzen

The students are able to:

- theoretically describe and explain the fundamentals of computer aided measurements and and adopt them practically
- apply the basics learned during the lecture to a practical problem in the form of a PC excercise

Group colloquia for each topic

Duration: approximately 10 minutes

no tools or reference materials may be used

Organizational issues
Ort und Zeit siehe Institutshomepage.
Praktikum findet in Präsenz statt, sofern die COVID-Inzidenzwerte es zulassen.

Literature
Germer, H.; Wefers, N.: Meßelektronik, Bd. 1, 1985
LabView User Manual
Hoffmann, Jörg: Taschenbuch der Messtechnik, 6., aktualisierte. Aufl. , 2011
Course: X-ray Optics [T-MACH-109122]

**Responsible:** Dr. Arndt Last  
**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-102597 - Compulsory Elective Module Mechanical Engineering  
M-MACH-102616 - Major Field: Microsystem Technology

<table>
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**Events**

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**Exams**

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**  
oral exam (about 20 min)

**Prerequisites**  
one

Below you will find excerpts from events related to this course:

**X-ray optics**  
2141007, SS 2021, 2 SWS, Language: English, [Open in study portal](#)  
Lecture (V)  
Blended (On-Site/Online)

**Content**  
see Institute homepage

If you are interested, please contact arndt.last@kit.edu by 24.4.2020 to make an appointment.

**Organizational issues**  
Viertägiger Blockkurs im März oder April 2022. Interessenten melden sich bitte zur Terminabsprache bis zum 31.1.2022 bei arndt.last@kit.edu

**X-ray Optics**  
2141007, WS 21/22, 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