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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).
Qualification Goals
Mechanical Engineering (B.Sc.)

Through a research and practical orientation of the six-semester Bachelor's degree program for mechanical engineering at KIT, graduates of the program are prepared for lifelong learning and employment in typical professional fields of mechanical engineering in industry, services, and public administration. They acquire the academic qualifications to pursue a Master's degree program in mechanical engineering or related disciplines.

In the fundamental area of the studies, graduates acquire sound basic knowledge in engineering. With this in-depth knowledge of scientific theories, principles, and methods, graduates can successfully deal with clearly specified problems that have a unique solution approach in mechanical engineering.

In the specialization area of the studies and in the thesis, cross-disciplinary problem-solving and synthesis skills for engineering systems are developed. Graduates are able to generate new solutions in the areas of their choice of engineering.

Graduates of the Bachelor's degree program in mechanical engineering at KIT can select basic methods in order to create models and compare them in familiar situations. They are able to take over and to work independently on preset problems and resulting tasks in organized teams, to integrate the results of others and to present and interpret their own results in written form. They can identify, analyze, and develop systems and processes, and apply predefined assessment criteria, taking into account technical, economic, and social constraints.
Inhalt

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

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Studien- und Prüfungsordnung
des Karlsruher Instituts für Technologie (KIT) für den Bachelorstudiengang 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 Bachelorprüfungsordnung regelt Studienablauf, Prüfungen und den Abschluss des Studiums im Bachelorstudiengang Maschinenbau am KIT.

§ 2 Ziel des Studiums, Akademischer Grad

(1) Im Bachelorstudium sollen die wissenschaftlichen Grundlagen und die Methodenkompetenz der Fachwissenschaften vermittelt werden. Ziel des Studiums ist die Fähigkeit, einen konsekutiven Masterstudiengang erfolgreich absolvieren zu können sowie das erworbene Wissen berufsfeldbezogen anwenden zu können.

(2) Aufgrund der bestandenen Bachelorprüfung wird der akademische Grad „Bachelor of Science (B.Sc.)“ für den Bachelorstudiengang Maschinenbau verliehen.

§ 3 Regelstudienzeit, Studienaufbau, Leistungspunkte

(1) Der Studiengang nimmt teil am Programm „Studienmodelle individueller Geschwindigkeit“. Die Studierenden haben im Rahmen der dortigen Kapazitäten und Regelungen bis einschließlich drittem Fachsemester Zugang zu den Veranstaltungen des MINT-Kollegs Baden-Württemberg (im folgenden MINT-Kolleg).

(2) Die Regelstudienzeit beträgt sechs Semester. Bei einer qualifizierten Teilnahme am MINT-Kolleg bleiben bei der Anrechnung auf die Regelstudienzeit bis zu zwei Semester unberücksichtigt. Die konkrete Anzahl der Semester richtet sich nach § 8 Absatz 2 Satz 3 bis 5.

Eine qualifizierte Teilnahme liegt vor, wenn die Studierende Veranstaltungen des MINT-Kollegs für die Dauer von mindestens einem Semester im Umfang von mindestens zwei Fachkursen (Gesamtworkload 10 Semesterwochenstunden) belegt hat. Das MINT-Kolleg stellt hierüber eine Bescheinigung aus.


(6) 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 Bachelorprüfung 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 Bachelorarbeit ist im Modulhandbuch geregelt.


(3) Zu einer Erfolgskontrolle ist zuzulassen, wer
   1. in den Bachelorstudiengang 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 Bachelorstudiengang 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.
(5) Die Zulassung ist abzulehnen, wenn die in Absatz 3 und 4 genannten Voraussetzungen nicht erfüllt sind.

§ 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. 5 zu berücksichtigen. 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.


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

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

Studierende, die sich in einem späteren Semester der gleichen Prüfung unterziehen wollen, werden entsprechend den räumlichen Verhältnissen und nach Zustimmung des Prüflings als Zuhörerinnen und Zuhörer bei mündlichen Prüfungen zugelassen. 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 einer solchen 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/ zur Prüfenden das Protokoll zeichnet.

Schriftliche Arbeiten im Rahmen einer Prüfungsleistung anderer Art haben dabei die folgende Erklärung zu tragen: „Ich versichere wahrheitsgemäß, die Arbeit selbstständig angefertigt, alle benutzten Hilfsmittel vollständig und genau angegeben und alles kenntlich gemacht zu haben,
was aus Arbeiten anderer unverändert oder mit Abänderungen entnommen wurde." Trägt die Arbeit diese Erklärung nicht, wird sie nicht angenommen. Die wesentlichen Gegenstände und Ergebnisse der 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 und fachliche Betreuung zu gewährleisten. 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:

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<tr>
<td>gut</td>
<td>eine Leistung, die erheblich über den durch-</td>
</tr>
<tr>
<td></td>
<td>schnittlichen Anforderungen liegt,</td>
</tr>
<tr>
<td>befriedigend</td>
<td>eine Leistung, die durchschnittlichen Anforde-</td>
</tr>
<tr>
<td></td>
<td>rungen entspricht,</td>
</tr>
<tr>
<td>ausreichend</td>
<td>eine Leistung, die trotz ihrer Mängel noch den</td>
</tr>
<tr>
<td></td>
<td>Anforderungen genügt,</td>
</tr>
<tr>
<td>nicht ausreichend</td>
<td>eine Leistung, die wegen erheblicher Mängel</td>
</tr>
<tr>
<td></td>
<td>nicht den Anforderungen genügt.</td>
</tr>
</tbody>
</table>

Zur differenzierten Bewertung einzelner Prüfungsleistungen sind nur folgende Noten zugelassen:

<table>
<thead>
<tr>
<th>Note</th>
<th>Bewertung</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,0; 1,3</td>
<td>sehr gut</td>
</tr>
<tr>
<td>1,7; 2,0; 2,3</td>
<td>gut</td>
</tr>
<tr>
<td>2,7; 3,0; 3,3</td>
<td>befriedigend</td>
</tr>
<tr>
<td>3,7; 4,0</td>
<td>ausreichend</td>
</tr>
<tr>
<td>5,0</td>
<td>nicht ausreichend</td>
</tr>
</tbody>
</table>

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

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 Bachelorprüfung, die Fachnoten und die Modulnoten lauten:

<table>
<thead>
<tr>
<th>Note</th>
<th>Wertung</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 Orientierungsprüfungen, Verlust des Prüfungsanspruchs

Die Teilmodulprüfungen Höhere Mathematik I, Technische Mechanik I, Technische Mechanik II in den Modulen Höhere Mathematik und Technische Mechanik sind bis zum Ende des Prüfungszeitraums des zweiten Fachsemesters abzulegen (Orientierungsprüfungen).

Wer die Orientierungsprüfungen einschließlich etwaiger Wiederholungen bis zum Ende des Prüfungszeitraums des dritten Fachsemesters nicht erfolgreich abgelegt hat, verliert den Prüfungsanspruch im Studiengang, es sei denn, dass die Fristüberschreitung nicht selbst zu vertreten ist; hierüber entscheidet der Prüfungsausschuss auf Antrag der oder des Studierenden. Eine zweite Wiederholung der Orientierungsprüfungen ist ausgeschlossen.

Die Fristüberschreitung hat die/der Studierende insbesondere dann nicht zu vertreten, wenn eine qualifizierte Teilnahme am MINT-Kolleg im Sinne von § 3 Abs. 2 vorliegt. Ohne ausdrückliche Genehmigung des Vorsitzenden des Prüfungsausschusses gilt eine Fristüberschreitung von

1. einem Semester als genehmigt, wenn die/der Studierende die qualifizierte Teilnahme am MINT-Kolleg gemäß § 3 Abs. 2 im Umfang von einem Semester nachweist oder
2. zwei Semestern als genehmigt, wenn die/der Studierende die qualifizierte Teilnahme am MINT-Kolleg gemäß § 3 Abs. 2 im Umfang von zwei Semestern nachweist.

Als Nachweis gilt die vom MINT-Kolleg gemäß § 3 Abs. 2 auszustellende Bescheinigung, die beim Studierendenservice des KIT einzureichen ist. Im Falle von Nr. 1 kann der Vorsitzende des Prüfungsausschusses auf Antrag der Studierenden die Frist um ein weiteres Semester verlängern, wenn dies aus studienorganisatorischen Gründen für das fristgerechte Ablegen der Orientierungsprüfung erforderlich ist, insbesondere weil die Module, die Bestandteil der Orientierungsprüfung sind, nur einmal jährlich angeboten werden.

Ist die Bachelorprüfung bis zum Ende des Prüfungszeitraums des neunten Fachsemesters einschließlich etwaiger Wiederholungen nicht vollständig abgelegt, so erlischt der Prüfungsanspruch.

(4) Der Prüfungsanspruch geht auch verloren, wenn eine nach dieser Studien- und Prüfungsordnung erforderliche Studien- oder Prüfungsleistung endgültig nicht bestanden ist oder eine Wiederholungsprüfung nach § 9 Abs. 6 nicht rechtzeitig erbracht wurde, es sei denn die Fristüberschreitung ist nicht selbst zu vertreten.

§ 9 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 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.


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

§ 10 Abmeldung; Versäumnis, Rücktritt

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


(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 Bachelorarbeit 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. In schwerwiegenden Fällen kann der Prüfungsausschuss diese Studierenden von der Erbringung weiterer Erfolgskontrollen ausschließen.

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

§ 12 Mutterschutz, Elternzeit, Wahrnehmung von Familienpflichten


(2) Gleichfalls sind die Fristen der Elternzeit nach Maßgabe des jeweils gültigen Gesetzes (Bundeselterngeld- und Elternzeitgesetz - BEEG) auf Antrag zu berücksichtigen. Der/die Studierende muss bis spätestens vier Wochen vor dem Zeitpunkt, von dem an die Elternzeit angetreten werden soll, dem Prüfungsausschuss, unter Beifügung der erforderlichen Nachweise schriftlich mitteilen, in welchem Zeitraum die Elternzeit in Anspruch genommen werden soll. Der Prüfungsausschuss hat zu prüfen, ob die gesetzlichen Voraussetzungen vorliegen, die bei einer Arbeitnehmerin bzw. einem Arbeitnehmer den Anspruch auf Elternzeit auslösen würden, und teilt

(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 § 20 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 Bachelorarbeit

(1) Voraussetzung für die Zulassung zum Modul Bachelorarbeit ist, dass die/der Studierende Modulprüfungen im Umfang von 120 LP erfolgreich abgelegt hat. Über Ausnahmen entscheidet der Prüfungsausschuss auf Antrag der/des Studierenden.


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


(5) Bei der Abgabe der Bachelorarbeit 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 unverändert 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 Bachelorarbeit mit „nicht ausreichend“ (5,0) bewertet.


§ 15 Zusatzleistungen


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


§ 16 Überfachliche Qualifikationen

Neben der Vermittlung von fachlichen Qualifikationen ist der Auf- und Ausbau überfachlicher Qualifikationen im Umfang von mindestens 6 LP Bestandteil eines Bachelorstudiums. Überfachliche Qualifikationen können additiv oder integrativ vermittelt werden.

§ 17 Prüfungsausschüsse


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


§ 18 Prüfende und Beisitzende
(1) Der Prüfungsausschuss bestellt die Prüfenden. Er kann die Bestellung der/dem Vorsitzenden übertragen.

(2) Prüfende sind Hochschullehr/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 Prüfungsbefugnis übertragen wurde; desgleichen kann wissenschaftlichen Mitarbeitern gemäß § 14 Abs. 3 Ziff. 2 KITG die Prüfungsbefugnis 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 diese zu Prüfenden bestellt werden, sofern die KIT-Fakultät eine Prüfungsbefugnis erteilt hat und sie 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.

§ 19 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 vorzunehmen. 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 Studiengang 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-
rektorenkonferenz gebilligten Äquivalenzvereinbarungen sowie Absprachen im Rahmen der Hochschulpartnerschaften zu beachten.

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


II. Bachelorprüfung

§ 20 Umfang und Art der Bachelorprüfung
(1) Die Bachelorprüfung besteht aus den Modulprüfungen nach Absatz 2 sowie dem Modul Bachelorarbeit (§ 14).
(2) Es sind Modulprüfungen in folgenden Pflichtfächern abzulegen:
   1. Ingenieurwissenschaftliche Grundlagen: Modul(e) im Umfang von 143 LP,
   2. Vertiefung im Maschinenbau: Modul(e) im Umfang von 16 LP,
   3. Überfachliche Qualifikationen im Umfang von 6 LP gemäß § 16.
Die Festlegung der zur Auswahl stehenden Module und deren Fachzuordnung werden im Modulhandbuch getroffen.

§ 21 Bestehen der Bachelorprüfung, Bildung der Gesamtnote
(1) Die Bachelorprüfung ist bestanden, wenn alle in § 20 genannten Modulprüfungen mindestens mit „ausreichend“ bewertet wurden.
(2) Die Gesamtnote der Bachelorprüfung errechnet sich als ein mit Leistungspunkten gewichteter Notendurchschnitt der Fachnoten sowie des Moduls Bachelorarbeit.
Dabei wird die Note des Moduls Bachelorarbeit mit dem doppelten Gewicht gegenüber den Noten der übrigen Fächer berücksichtigt.
(3) Haben Studierende die Bachelorarbeit mit der Note 1,0 und die Bachelorprüfung mit einem Durchschnitt von 1,2 oder besser abgeschlossen, so wird das Prädikat „mit Auszeichnung“ (with distinction) verliehen.

§ 22 Bachelorzeugnis, Bachelorurkunde, Diploma Supplement und Transcript of Records

(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

§ 23 Bescheinigung von Prüfungsleistungen
Haben Studierende die Bachelorprüfung 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 erschöpft ist.

§ 24 Aberkennung des Bachelorgrades
(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 Bachelorprüfung für „nicht bestanden“ erklärt werden.

(2) Waren die Voraussetzungen für die Zulassung zu einer Prüfung nicht erfüllt, ohne dass 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 Bachelorprüfung 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 Bachelorurkunde einzuziehen, wenn die Bachelorprüfung aufgrund einer Täuschung für „nicht bestanden“ erklärt wurde.


(6) Die Aberkennung des akademischen Grades richtet sich nach § 36 Abs. 7 LHG.
§ 25 Einsicht in die Prüfungsakten
(1) Nach Abschluss der Bachelorprüfung wird den Studierenden auf Antrag innerhalb eines Jahres Einsicht in das Prüfungsexemplar ihrer Bachelorarbeit, 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.

§ 26 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)
Inhalt

Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Bachelor-studiengang Maschinenbau
Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Bachelorstudiengang 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. § 9 Absatz 11 werden folgende Sätze 3 und 4 angefügt:

„Die Präsentation nach § 14 Absatz 1 a ist eine Studienleistung und kann bei einer Bewertung mit „nicht bestanden (not passed)“ (im Gegensatz zu anderen Studienleistungen) nur einmal wiederholt werden. Die Präsentation ist endgültig nicht bestanden, wenn sie zweimal mit „nicht bestanden“ (not passed) bewertet wurde.“

2. § 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

3. § 14 wird wie folgt geändert:


b) 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.

c) 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.
4. § 17 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.

5. § 18 Absatz 3 wird wie folgt geändert:
   Nach dem Wort „sofern“ werden die Wörter „die KIT-Fakultät eine Prüfungsbefugnis erteilt hat und“ gestrichen.

6. § 26 Absatz 5 wird aufgehoben und folgender neuer Absatz 5 eingefügt:
   „(5) Für Studierende, die
   1. ihr Studium im Bachelorstudiengang Maschinenbau vor dem Wintersemester 2018/2019 aufgenommen haben oder
   2. ihr Studium im Bachelorstudiengang Maschinenbau ab dem Wintersemester 2018/2019 in einem höheren Fachsemester aufgenommen haben bzw. aufnehmen sofern das Fachsemester über dem Jahrgang der Studienanfänger zum Wintersemester 2018/2019 liegt,
   finden § 9 Abs. 11 und § 14 Abs. 1 a in der Fassung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Bachelorstudiengang Maschinenbau vom 04. August 2015 (Amtliche Bekanntmachung des KIT Nr. 62 vom 06. August 2015) weiterhin Anwendung.

   Studierende nach Satz 1 Ziffer 1 und Ziffer 2, können das Modul Bachelorarbeit auf Grundlage der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Bachelorstudiengang Maschinenbau in der Fassung vom 04. August 2015 (Amtliche Bekanntmachung des KIT Nr. 62 vom 06. August 2015) letztmalig bis zum 31. März 2023 ablegen“

Artikel 2 – Inkrafttreten

Diese Änderungssatzung tritt zum 01. April 2019 in Kraft.

Karlsruhe, den 21. Februar 2019

gez. Prof. Dr.-Ing. Holger Hanselka
(Präsident)
Studienplan der KIT-Fakultät für Maschinenbau
für den Bachelorstudiengang Maschinenbau
gemäß SPO 2015

Fassung vom 01.12.2021
letzte redaktionelle Änderung am 18.01.2024

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</tr>
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<tbody>
<tr>
<td></td>
<td>SS</td>
<td>Sommersemester</td>
</tr>
</tbody>
</table>

| Schwerpunkte: | K, KP | Teilleistung im Kernbereich, ggf. Pflicht des Schwerpunkts |
|               | E   | Teilleistung im Ergänzungsbereich des Schwerpunkts |
|               | EM  | Teilleistung im Ergänzungsbereich ist nur im Masterstudiengang wählbar |
|               | E(P), E/P | Teilleistung Praktikum im Ergänzungsbereich des Schwerpunkts, unbenotet |

| Lehrveranstaltung: | V | Vorlesung |
|                   | Ü | Übung |
|                   | P | Praktikum |
|                   | SWS | Semesterwochenstunden |

| Teilleistung: | LP | Leistungspunkte |
|              | Pr | Prüfung |
|              | Pr (h) | Prüfungsdauer in Stunden |
|              | mPr | mündliche Prüfung |
|              | sPr | schriftliche Prüfung |
|              | PraA | Prüfungsleistung anderer Art |
|              | Üschein | Übungsschein, Studienleistung |
|              | Pschein | Praktikumschein, Studienleistung |
|              | Schein | unbenotete Moduleistung, Studienleistung |
|              | TL | Teilleistung |
|              | Gew | Gewichtung einer Prüfungsleistung im Modul bzw. in der Gesamtnote |

| Sonstiges: | SPO | Studien- und Prüfungsordnung |
|           | w | wählbar |
|           | p | verpflichtend |
1 Studienpläne, Module und Prüfungen

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


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

1.2 Module des Bachelorstudiums


<table>
<thead>
<tr>
<th>Fach</th>
<th>Modul</th>
<th>LP/ Modul</th>
<th>Teilleistung</th>
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</table>
| Schwerpunkt
| Vertiefung im Maschinenbau  | Kern- und Ergänzungsbereich, wählbare TL siehe Modulhandbuch | 12       | 12           |    | SP-Verantwortlicher | mPr                      | 12   |
| Wahlpflichtmodul             | wählbare TL siehe Modulhandbuch           | 4        | 4            |    | Heilmaier   | mPr                      | 4    |
| Schlüsselqualifikationen     | Arbeitstechniken im Maschinenbau          | 4        | 4            |    | Deml        | Schein                   |      |
|                              | wählbare TL von HoC, ZAK bzw. siehe Modulhandbuch | 2        | 2            |    | N.N.        | Schein                   |      |
| Bachelorarbeit               | Bachelorarbeit                             | 15       | 15           |    |             | PraA                      | 30   |
|                              | Präsentation                              | 3        |              |    |             |                          |      |

### 1.3 Studienplan

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<td>Strömungslehre II</td>
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### 1.4 Bachelorarbeit

Das Modul Bachelorarbeit besteht aus einer schriftlichen Ausarbeitung (Bachelorarbeit, 12 LP) sowie einer mündlichen Präsentation (3 LP). Die Präsentation soll spätestens sechs Wochen nach Abgabe der Bachelorarbeit erfolgen. Die Präsentation soll ca. 20 Minuten dauern und wird anschließend mit dem anwesenden Fachpublikum diskutiert.

Die Durchführung und Benotung der Bachelorarbeit ist in § 14 der SPO für den Bachelorstudiengang Maschinenbau sowie im Modulhandbuch unter „Modul Bachelorarbeit“ geregelt.

---

1 Das Werkstoffkunde-Praktikum findet in der vorlesungsfreien Zeit zwischen SS und WS statt und beansprucht eine Woche.
2 Schwerpunkte

Folgende Schwerpunkte sind derzeit vom Fakultätsrat genehmigt (siehe Angaben im Modulhandbuch):

<table>
<thead>
<tr>
<th>Schwerpunkt</th>
<th>Verantwortlicher</th>
<th>SP-Nr.</th>
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<tbody>
<tr>
<td>Antriebssysteme</td>
<td>Albers</td>
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<tr>
<td>Bahnsystemtechnik</td>
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<tr>
<td>Entwicklung und Konstruktion</td>
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<td>Kontinuumsmechanik</td>
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<td>Grundlagen der Energietechnik</td>
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<td>Informationsmanagement</td>
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<td>Informationstechnik</td>
<td>Stiller</td>
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</tr>
<tr>
<td>Kraftfahrzeugtechnik</td>
<td>Gauterin</td>
<td>12</td>
</tr>
<tr>
<td>Kraft- und Arbeitsmaschinen</td>
<td>Th. Koch</td>
<td>24</td>
</tr>
<tr>
<td>Materialwissenschaft und Werkstofftechnik</td>
<td>Heilmayer</td>
<td>26</td>
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<tr>
<td>Mechatronik</td>
<td>Hagenmeyer</td>
<td>31</td>
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<tr>
<td>Modellbildung und Simulation in der Dynamik</td>
<td>Fidlin</td>
<td>61</td>
</tr>
<tr>
<td>Produktionssysteme</td>
<td>Schulze</td>
<td>38</td>
</tr>
<tr>
<td>Schwingungsliehe</td>
<td>Fidlin</td>
<td>60</td>
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<td>Technische Logistik</td>
<td>Furmans</td>
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<tr>
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</table>

Für den Schwerpunkt werden Teilleistungen im Umfang von 12 LP gewählt, davon werden mindestens 8 LP im Kernbereich (K) erworben. „KP“ bedeutet, dass die Teilleistung im Kernbereich Pflicht ist, sofern sie nicht bereits belegt wurde. Die übrigen 4 LP können aus dem Ergänzungsbereich kommen. Dabei dürfen im Rahmen von Praktika höchstens 4 LP erworben werden, die auch als unbenotete Moduleistung erbracht werden können.


Ein Absolvieren des Schwerpunktsmoduls mit mehr als 12 LP ist nur im Fall, dass die Addition innerhalb des Schwerpunktsmoduls nicht auf 12 LP aufgeht, erlaubt. Nicht zulässig ist es jedoch, noch weitere Teilleistungen anzumelden, wenn bereits 12 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.


Die Beschreibung der Schwerpunkte hinsichtlich der jeweils darin enthaltenen Teilleistungen und den damit verbundenen Lehrveranstaltungen ist im aktuellen Modulhandbuch des Bachelorstudiengangs festgelegt.
3 Änderungshistorie (ab 20.07.2016)

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<th>Datum</th>
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### 6 Field of study structure

#### Mandatory

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<th>Orientation Exam</th>
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<tr>
<td>Fundamentals of Engineering</td>
<td>143 CR</td>
</tr>
<tr>
<td>Specialization in Mechanical Engineering</td>
<td>16 CR</td>
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<tr>
<td>Interdisciplinary Qualifications</td>
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#### Voluntary

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#### 6.1 Orientation Exam

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#### 6.2 Bachelor's Thesis

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#### 6.3 Fundamentals of Engineering

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<td>Physics</td>
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<tr>
<td>Measurement and Control Systems</td>
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<td>Computer Science</td>
<td>6 CR</td>
</tr>
<tr>
<td>Mechanical Design</td>
<td>20 CR</td>
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<tr>
<td>Machines and Processes</td>
<td>7 CR</td>
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<td>Manufacturing Processes</td>
<td>4 CR</td>
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<tr>
<td>Sustainable Production Economics</td>
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First usage possible from 10/1/2022.
### 6.4 Specialization in Mechanical Engineering

**Mandatory**

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**Major Field (Election: 1 item)**

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<td>M-MACH-102638</td>
<td>Major Field: Rail System Technology</td>
<td>12 CR</td>
</tr>
<tr>
<td>M-MACH-102815</td>
<td>Major Field: Engineering Design</td>
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</tr>
<tr>
<td>M-MACH-102582</td>
<td>Major Field: Continuum Mechanics</td>
<td>12 CR</td>
</tr>
<tr>
<td>M-MACH-102816</td>
<td>Major Field: Fundamentals of Energy Technology</td>
<td>12 CR</td>
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<tr>
<td>M-MACH-102583</td>
<td>Major Field: Information Management</td>
<td>12 CR</td>
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<td>M-MACH-102817</td>
<td>Major Field: Information Technology</td>
<td>12 CR</td>
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<tr>
<td>M-MACH-102818</td>
<td>Major Field: Vehicle Technology</td>
<td>12 CR</td>
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<tr>
<td>M-MACH-102838</td>
<td>Major Field: Energy Converting Engines</td>
<td>12 CR</td>
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<tr>
<td>M-MACH-102819</td>
<td>Major Field: Materials Science and Engineering</td>
<td>12 CR</td>
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<tr>
<td>M-MACH-102820</td>
<td>Major Field: Mechatronics</td>
<td>12 CR</td>
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<td>M-MACH-104430</td>
<td>Major Field: Modeling and Simulation in Dynamics</td>
<td>12 CR</td>
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<tr>
<td>M-MACH-102589</td>
<td>Major Field: Production Systems</td>
<td>12 CR</td>
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<td>M-MACH-104442</td>
<td>Major Field: Vibration Theory</td>
<td>12 CR</td>
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<td>M-MACH-102645</td>
<td>Major Field: Combustion Engine Techniques</td>
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<td>M-MACH-102821</td>
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### 6.5 Interdisciplinary Qualifications

**Mandatory**

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Key Competences</th>
<th>Credits</th>
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<tr>
<td>M-MACH-102576</td>
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<td>6 CR</td>
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### 6.6 Additional Examinations

**Additional Examinations (Election: at most 30 credits)**

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Supplementary Studies on Sustainable Development First usage possible from 4/1/2023.</th>
<th>Credits</th>
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<tbody>
<tr>
<td>M-ZAK-106099</td>
<td>Supplementary Studies on Sustainable Development First usage possible from 4/1/2023.</td>
<td>19 CR</td>
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<td>M-ZAK-106235</td>
<td>Supplementary Studies on Culture and Society First usage possible from 4/1/2023.</td>
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### 7 Modules

#### 7.1 Module: Advanced Mathematics [M-MATH-102859]

<table>
<thead>
<tr>
<th>Credits</th>
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<table>
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<tbody>
<tr>
<td>T-MATH-100525</td>
<td>Tutorial Advanced Mathematics I</td>
<td>0 CR</td>
<td>Arens, Griesmaier, Hettlich</td>
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<tr>
<td>T-MATH-100526</td>
<td>Tutorial Advanced Mathematics II</td>
<td>0 CR</td>
<td>Arens, Griesmaier, Hettlich</td>
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<td>T-MATH-100527</td>
<td>Tutorial Advanced Mathematics III</td>
<td>0 CR</td>
<td>Arens, Griesmaier, Hettlich</td>
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<td>T-MATH-100276</td>
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<td>T-MATH-100277</td>
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<td>7 CR</td>
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</table>

**Competence Certificate**

Learning assessment is carried by three written examinations of length 120 minutes each and by three sets of homework assignments (pre-requisites). A "pass" result on a pre-requisites in Advanced Mathematics I, II and III, respectively, is a requirement for registration for the corresponding written examination.

**Prerequisites**

None.

**Competence Goal**

The students know the fundamentals of one-dimensional calculus. They can reliably use limits, functions, power series and integrals. They understand central concepts such as continuity, differentiability or integrability and they know important statements about these concepts. The students can follow the arguments leading to these statements as presented in the lectures and are able to independently prove simple assertions based on these statements.

The students know about the fundamentals of linear algebra. They are able to use vectors, linear maps and matrices without problems. They have basic knowledge about Fourier series. The students also can theoretically and practically deal with initial value problems of ordinary differential equations. They can make use of classical solution techniques for linear differential equations.

The students know about differential calculus for vector-valued functions of several variables and about techniques of vector calculus such as the definition and application of differential operators, the computation of domain, line and surface integrals and important integral theorems. They have basic knowledge about partial differential equations and know basic facts from stochastics.

**Content**

Workload

In class: 270 hours

- lectures, tutorials and examinations

Independent study: 360 hours

- independent review of course material
- work on homework assignments
- preparation for written exams

Learning type

Lecture, problem classes, tutorials
Module: Bachelor's Thesis [M-MACH-104494]

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

<table>
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<td>Bachelor's Thesis</td>
<td>12 CR</td>
<td>Heilmaier</td>
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<tr>
<td>T-MACH-109189</td>
<td>Presentation</td>
<td>3 CR</td>
<td>Heilmaier</td>
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</table>

Competence Certificate

The module Bachelor Thesis consists of a written bachelor thesis and an oral presentation of a scientific subject chosen by the student himself/herself or given by the supervisor. The bachelor 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 work load of the bachelor thesis corresponds to 12 ECTS. The maximal processing time of the bachelor thesis takes three months.

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 bachelor 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 bachelor thesis is not completed in time, this examination is "failed" (5.0), unless the student is not responsible.

The bachelor thesis is to be evaluated not less than by a professor or a senior scientist according to § 14 Abs. 3 Ziff. 1 KITG for 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 bachelor thesis is graded by the examination board within this assessment; another expert can be appointed too. The bachelor 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 bachelor thesis. The presentation should last around 20 minutes, corresponds to 3 ECTS, and is followed by a scientific discussion with the present expert audience.

Prerequisites

The requirement for admission to the bachelor thesis module are 120 ECTS. As to exceptions, the examination board decides on a request of the student (see § 14 (1) SPO).

Modeled Conditions

The following conditions have to be fulfilled:

1. You need to have earned at least 120 credits in the following fields:
   - Fundamentals of Engineering
   - Interdisciplinary Qualifications
   - Specialization in Mechanical Engineering

Competence Goal

The student is able to work independently on a defined, subject-relevant theme based on scientific criteria within a given period of time. The student is able to do research, 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 a question, is able to choose scientific methods and techniques, and use them to solve the question or to identify other potentials. In general, 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. He/she is able to clearly structure a scientific work and (a) to communicate it in written form using technical terminology as well as (b) to present it in oral form and discuss it with experts.

Content

The student shall be allowed to make suggestions for the topic of his/her bachelor 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 bachelor thesis is about 450 hours.
### 7.3 Module: Compulsory Elective Module (BSc-Modul WPF) [M-MACH-102746]

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Specialization in Mechanical Engineering (mandatory)

<table>
<thead>
<tr>
<th>Credits</th>
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<th>Duration</th>
<th>Language</th>
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#### Compulsory Elective Module (Election: 1 item)

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<tr>
<td>T-MACH-105381</td>
<td>Virtual Engineering (Specific Topics)</td>
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<td>Ovtcharova</td>
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<td>T-MACH-112717</td>
<td>Dimensioning of Additive-Manufactured Polymer Structures at an Example from Medical Engineering</td>
<td>4</td>
<td>Käger</td>
</tr>
<tr>
<td>T-MACH-105212</td>
<td>CAE-Workshop</td>
<td>4</td>
<td>Albers, Matthiesen</td>
</tr>
<tr>
<td>T-MACH-105320</td>
<td>Introduction to the Finite Element Method</td>
<td>3</td>
<td>Bühike, Langhoff</td>
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<tr>
<td>T-MACH-100535</td>
<td>Introduction into Mechatronics</td>
<td>6</td>
<td>Böhland, Reischl</td>
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<tr>
<td>T-MACH-105209</td>
<td>Introduction to Multi-Body Dynamics</td>
<td>5</td>
<td>Römer</td>
</tr>
<tr>
<td>T-MACH-110362</td>
<td>Introduction to Computational Fluid Dynamics</td>
<td>3</td>
<td>Frohnapfel, Stroh</td>
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<tr>
<td>T-MACH-102093</td>
<td>Fluid Power Systems</td>
<td>4</td>
<td>Geimer</td>
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<td>T-MACH-109919</td>
<td>Basics of Technical Logistics I</td>
<td>4</td>
<td>Mittwollen, Oellerich</td>
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<tr>
<td>T-MACH-105213</td>
<td>Fundamentals of Combustion I</td>
<td>4</td>
<td>Maas</td>
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<tr>
<td>T-MACH-110377</td>
<td>Continuum Mechanics of Solids and Fluids</td>
<td>3</td>
<td>Bühike, Frohnapfel</td>
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<tr>
<td>T-MACH-105210</td>
<td>Machine Dynamics</td>
<td>5</td>
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<td>Mathematical Methods in Dynamics</td>
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<td>T-MACH-110375</td>
<td>Mathematical Methods in Continuum Mechanics</td>
<td>4</td>
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<td>T-MACH-105294</td>
<td>Mathematical Methods of Vibration Theory</td>
<td>6</td>
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<td>T-MACH-105303</td>
<td>Modelling of Microstructures</td>
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<td>August, Nestler</td>
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<td>T-MACH-100300</td>
<td>Modelling and Simulation</td>
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<td>Gumbsch, Nestler</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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<tr>
<td>T-MACH-102102</td>
<td>Physical Basics of Laser Technology</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>
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<td>5</td>
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<td>Integrated Information Systems for Engineers</td>
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<td>T-MACH-105292</td>
<td>Heat and Mass Transfer</td>
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<td>T-MACH-100532</td>
<td>Scientific Computing for Engineers</td>
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#### Compulsory Elective Module (Tutorial) (Election: )

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<td>T-MACH-110330</td>
<td>Tutorial Introduction to the Finite Element Method</td>
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<td>T-MACH-111033</td>
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<td>1</td>
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<td>T-MACH-110333</td>
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<td>Tutorial Mathematical Methods in Continuum Mechanics</td>
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**Competence Certificate**  
oral/written exam

**Prerequisites**  
None
Competence Goal
The students have deepened their knowledge in selected areas of mechanical engineering. Due to the broad variety of eligible courses, they have supplemented / sharpened their own competence profile in mechanical engineering individually and precisely.

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

Content
See brick courses.

Annotation
Compulsory elective subjects have to be chosen from the corresponding catalogues as displayed in the bachelor’s program with an amount of 4 credit points (see Studienplan or Module Handbook)

Workload
The work load is about 120 hours, corresponding to 4 credit points. The work load 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
Lectures, Tutorials
7.4 Module: Computer Science (BSc-Modul 09, Inf) [M-MACH-102563]

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Fundamentals of Engineering

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<tr>
<td>T-MACH-105205</td>
<td>Computer Science for Engineers</td>
<td>6</td>
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<td>1 term</td>
<td>German/English</td>
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</table>
| T-MACH-105206 | Computer Science for Engineers, Prerequisite  
This item will not influence the grade calculation of this parent. | 0       | CR      | Each summer term | 1 term   | German/English | 3     | 2       |

**Competence Certificate**

Written examination "Computer Science for Engineers", 100%, 180 minutes; Examination prerequisite: passed lap course.

**Prerequisites**

None

**Competence Goal**

Students can identify and explain fundamental terms, problems and concepts of computer science. They can apply the basic methods of the OO modeling with UML and implement the object-oriented programming (OOP) with the programming language JAVA.

**Content**

Basics: Information representation- and processing, terms and definitions: alphabet, data, signals, information, numeral systems, propositional logic and Boolean algebra, computer architectures, programming paradigms.

Object Orientation: Definition and important characteristics of object orientation, Object-oriented modeling with UML.

Data Structures: Definition, properties and application of graphs, trees, linked lists, queues and stacks.

Algorithms: Characteristics of algorithms, complexity analysis, design methods, important examples.

Database management systems: Relational data model, relational algebra, declarative language SQL. Basics and concepts of JAVA. Introduction to programming using JAVA.

**Module grade calculation**

Examination result "Computer Science for Engineers" 100%

**Annotation**

For the Bachelor's program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.

For the Bachelor's program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

**Workload**

Attendance time: 63 hours

Self-study: 117 hours

**Learning type**

Lecture and Lab Course
### 7.5 Module: Electrical Engineering [M-ETIT-104801]

**Responsible:** Prof. Dr. Martin Doppelbauer  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** Fundamentals of Engineering (Usage from 3/8/2019)

<table>
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<td>Electrical Engineering and Electronics</td>
<td>8 CR</td>
<td>Doppelbauer</td>
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</table>
**7.6 Module: Engineering Mechanics (BSc-Modul 03, TM) [M-MACH-102572]**

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

<table>
<thead>
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<td>Engineering Mechanics I</td>
<td>7 CR</td>
<td>Böhlke, Langhoff</td>
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<td>T-MACH-100283</td>
<td>Engineering Mechanics II</td>
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<td>Engineering Mechanics III &amp; IV</td>
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**Competence Certificate**

- Engineering Mechanics I (T-MACH-100282): written exam, 90 minutes, graded. Additives as announced  
- Engineering Mechanics II (T-MACH-100283): written exam, 90 minutes, graded. Additives as announced  
- Engineering Mechanics III/IV (T-MACH-105201): written exam, 180 minutes, graded. Additives as announced  
- Coursework in *Tutorial Engineering Mechanics I* (T-MACH-100528) must be passed for admission to the exam Engineering Mechanics I.  
- Coursework in *Tutorial Engineering Mechanics II* (T-MACH-100284) must be passed for admission to the exam Engineering Mechanics II.  

**Prerequisites**  
None

**Competence Goal**  
After completion of this module, the students can:

- compute and evaluate 3D stress and strain states within the framework of linear elasticity and thermoelasticity  
- apply the principle of virtual displacements  
- apply energy methods and evaluate approximate solutions  
- evaluate the stability of equilibrium positions  
- solve worksheet problems to topics of the lecture using the computer algebra system MAPLE

In EM III and EM IV the students learn to analyse the motion of points and systems. Based on the axioms of Newton and Euler they know how to derive equations of motion. Besides the synthetic methods they get familiar with analytical methods which are based on energy expressions and can be applied efficiently and formalised. These methods are introduced in the scope of systems of mechanical engineering so that students can determine and analyse motions and the forces which are generated by these motions.
Content
This Module consists of the courses "Engineering Mechanics I (lecture)" up to "Engineering Mechanics IV (lecture)" as well as "Engineering Mechanics I (Tutorial)" up to "Engineering Mechanics IV (Tutorial)"

Contents of "Engineering Mechanics I": basics of vector calculus; force systems; statics of rigid bodies; internal forces and moments in bars and beams; friction; centre of gravity, centre of mass; work, energy, principle of virtual work; statics of inextensible ropes; elastostatics of tension-compression-bars
Contents of "Engineering Mechanics II": bending; shear; torsion; stress and strain state in 3D; Hooke's law in 3D; elasticity theons in 3D; energy methods in elastostatics; approximation methods; stability
Contents of "Engineering Mechanics III":
Kinetics of a particle:
Newton's axiom, Principle of d'Alembert, work of a force, kinetic and potential energies, principle of linear momentum, principle of moment of momentum, kinetics in moving reference systems
Systems of particles:
Principle of center of mass, Principle of moment of momentum, impacts between particles, systems with variable mass, applications.
Plain motion of rigid bodies:
Contents of "Engineering Mechanics IV":
Spatial kinematics of a rigid body, Euler angles, angular velocity using Euler angles, Euler's equations, inertia tensor, kinetic energy of a rigid body, free gyroscopes, forced gyroscopes, systems of rigid bodies, principle of d'Alembert, Lagrange's equations of the first and second kind, generalized coordinates, free and forced vibration of one degree of freedom systems, frequency response, vibration of multi degree of freedom systems, vibration absorption

Module grade calculation
The final grade of this module is computed as CP-based weighted sum of the included exams.

Annotation
For the Bachelor's program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.
For the Bachelor's program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

Workload
lectures and exercises: 204h
homework and preparation of examination: 486h

Learning type
Lectures, Tutorials, Lab course groups, attestation of solved work sheets, colloquium, consultation hours
### 7.7 Module: Fluid Mechanics (BSc-Modul 12, SL) [M-MACH-102565]

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

**Credits:** 8  
**Grading scale:** Grade to a tenth  
**Recurrence:** Each summer term  
**Duration:** 2 terms  
**Language:** German/English  
**Level:** 3  
**Version:** 1  

<table>
<thead>
<tr>
<th>Mandatory</th>
<th>T-MACH-105207</th>
<th>Fluid Mechanics 1&amp;2</th>
<th>8 CR</th>
<th>Frohnapfel</th>
</tr>
</thead>
</table>

**Competence Certificate**  
Common examination of "Fluid Mechanics I" and "Fluid Mechanics II"; written exam, 3 hours (graded)

**Prerequisites**  
none

**Competence Goal**  
After having completed this module the student is capable of deriving the mathematical equations that describe the motion of fluids and can determine flow quantities for generic problems. He/she can name characteristic properties of fluids and distinguish different flow states. The student is capable of determining fluid quantities in fundamental applications. This includes the calculation of:

- static and dynamic forces acting from the fluid onto the solid
- two-dimensional viscous flows
- one-dimensional incompressible and compressible flows without losses
- lossy flows through pipes

**Content**  
properties of fluids, surface tension, hydro- and aerostatics, kinematics, stream tube theory (compressible and incompressible), losses in pipeline systems, dimensional analysis, dimensionless numbers

tensor notation, fluid elements in continuum, Reynolds transport theorem, conservation of mass and momentum, continuity equation, constitutive law for Newtonian fluids, Navier-Stokes equations, angular momentum and energy conservation, integral form of the conservation equations, forces between fluids and solids, analytical solutions of the Navier-Stokes equations

**Module grade calculation**  
result of exam

**Annotation**  
For the Bachelor’s program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.

For the Bachelor’s program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

**Workload**  
regular attendance: 64 hours  
self-study: 176 hours

**Learning type**  
Lectures + tutorials

**Literature**  
Zirep J., Bühler, K.: Grundzüge der Strömungslehre, Grundlagen, Statik und Dynamik der Fluide, Springer Vieweg  
Kuhlmann, H.: Strömungsmechanik, Pearson Studium  
Spurk, J.H.: Strömungslehre, Einführung in die Theorieder Strömungen, Springer-Verlag  
7.8 Module: Key Competences (BSc-Modul 07, SQL) [M-MACH-102576]

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

**Part of:** Interdisciplinary Qualifications

**Credits:** 6  
**Grading scale:** pass/fail  
**Recurrence:** Each term  
**Duration:** 1 term  
**Language:** German/English  
**Level:** 3  
**Version:** 3

**Election notes**  
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".

<table>
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<tr>
<th>Mandatory</th>
<th>Key Competences (Election: at least 2 credits)</th>
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<tbody>
<tr>
<td>T-MACH-105296 Working Methods in Mechanical Engineering</td>
<td>4 CR Deml</td>
</tr>
<tr>
<td>T-MACH-110961 Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example</td>
<td>2 CR Grube</td>
</tr>
<tr>
<td>T-MACH-111684 Self-Booking-BSc-HOC-SPZ-ZAK-Non-Graded</td>
<td>2 CR Heilmaier</td>
</tr>
<tr>
<td>T-MACH-111685 Self-Booking-BSc-HOC-SPZ-ZAK-Graded</td>
<td>2 CR Heilmaier</td>
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</tbody>
</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.

**Prerequisites**  
none

**Competence Goal**  
After completing the module Key Competences students can

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

**Content**  
The module Key Competences consists "Working Methods in Mechanical Engineering" and a freely selectable courses offered by the KIT-House of Competence (HoC), the KIT Language Centre (SPZ), the Centre for Cultural and General Studies (ZAK), and the brick courses contained in the elective block of key qualifications with a work load corresponding to a total of 2 ECTS.  
Upon request, the examination board may approve further courses as freely selectable subjects in the module "Key Competences".

**Module grade calculation**  
non graded
Workload
The work load is about 180 hours, corresponding to 6 credit points in the Bachelor of Science program.

Learning type
The teaching and learning methods depend on the respectively chosen courses. The courses can be lectures, seminars, tutorials, or lab courses.
7.9 Module: Machines and Processes (mach13BSc-Modul 13, MuP) [M-MACH-102566]

Responsible: Dr.-Ing. Heiko Kubach
Organisation: KIT Department of Mechanical Engineering

Part of: Fundamentals of Engineering

<table>
<thead>
<tr>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Duration</th>
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<th>Level</th>
<th>Version</th>
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<td>Each winter term</td>
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Mandatory

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<tr>
<td>7 CR</td>
<td>Machines and Processes</td>
<td>Bauer, Kubach, Maas, Pritz</td>
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<tr>
<td>0 CR</td>
<td>Machines and Processes, Prerequisite</td>
<td>Bauer, Kubach, Maas, Pritz</td>
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</tbody>
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Competence Certificate
written exam (2 h)

Prerequisites
None.

Competence Goal
The students can name and describe basic energy conversion processes and energy converting machines. They can explain the application of these energy conversion processes in various machines. They can analyze and evaluate the processes and machines in terms of functionality and efficiency and they are able to solve basic technical problems in terms of operating the machines.

Content
- Introduction to power engineering
- Radial and axial turbines
- Pumps
- Compressors
- Blowers
- Wind turbines
- Fuel cells
- Energy storage
- E-motors
- Heat pumps
- Combined heat and power
- Diesel engines
- Gasoline engines
- Hydrogen engines

Module grade calculation
Grade out of written exam (100%)

Annotation
For the Bachelor's program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.
For the Bachelor's program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

Workload
regular attendance: 48 h
self-study: 162 h

Learning type
Lecture+Tutorial
Lab Course
### 7.10 Module: Major Field: Combustion Engine Techniques (SP 57) [M-MACH-102645]

<table>
<thead>
<tr>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Duration</th>
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<td>Each term</td>
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#### Combustion Engine Techniques (K) (Election: at least 3 credits)

<table>
<thead>
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<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Responsible</th>
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<tbody>
<tr>
<td>T-MACH-111623</td>
<td>Fuels and Lubricants for Engine Powertrains</td>
<td>4 CR</td>
<td>Kehrwald, Kubach</td>
</tr>
<tr>
<td>T-MACH-110817</td>
<td>Development of Hybrid Drivetrains</td>
<td>4 CR</td>
<td>Koch</td>
</tr>
<tr>
<td>T-MACH-105169</td>
<td>Engine Measurement Techniques</td>
<td>4 CR</td>
<td>Bernhardt</td>
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#### Combustion Engine Techniques (E) (Election: at most 1 item)

<table>
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<th>Credits</th>
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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-105649</td>
<td>Boosting of Combustion Engines</td>
<td>4 CR</td>
<td>Kech, Kubach</td>
</tr>
<tr>
<td>T-MACH-110816</td>
<td>Großdiesel- und -gasmotoren für Schiffsantriebe</td>
<td>4 CR</td>
<td>Kubach</td>
</tr>
<tr>
<td>T-MACH-105044</td>
<td>Fundamentals of Catalytic Exhaust Gas Aftertreatment</td>
<td>4 CR</td>
<td>Deutschmann, Grunwaldt, Kubach, Lox</td>
</tr>
<tr>
<td>T-MACH-105337</td>
<td>Engine Laboratory</td>
<td>4 CR</td>
<td>Wagner</td>
</tr>
<tr>
<td>T-MACH-111578</td>
<td>Sustainable Vehicle Drivetrains</td>
<td>4 CR</td>
<td>Koch, Toedter</td>
</tr>
<tr>
<td>T-MACH-111591</td>
<td>Turbo Charging of Internal Combustion Engines</td>
<td>4 CR</td>
<td>Kech, Kubach</td>
</tr>
<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-113265</td>
<td>Tools for HPC and AI in Engineering</td>
<td>4 CR</td>
<td>Braun</td>
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#### Mandatory

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<tbody>
<tr>
<td>T-MACH-112799</td>
<td>Fundamentals of Combustion Engine Technology</td>
<td>5 CR</td>
<td>Bernhardt, Kubach, Pfeil, Toedter, Wagner</td>
</tr>
</tbody>
</table>

**Competence Certificate**

oral exam, written exam, lab course reports (see description of bricks)

**Prerequisites**

None

**Competence Goal**

After completion of this „Schwerpunkt“ students are able to

- Describe and explain the working principal of different engine types
- Name the challenges in engine development
- Describe the correlations between engine operation, application parameters and emissions

**Content**

The focus of this “Schwerpunkt” are the basic design and the working principle of internal combustion engines. Different types of engines such as gasoline engine, diesel engine and gas engine are subject. The fundamental thermodynamic aspects as well as the mechanical aspects are discussed. The influence of application parameters and the correlation of engine concepts, fuels and emissions are addressed.

**Workload**

The work load is 360 hours, corresponding to 12 credit points.

**Learning type**

Lectures, Exercises, Lab Courses
# 7.11 Module: Major Field: Continuum Mechanics (SP 13) [M-MACH-102582]

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

**Part of:** Specialization in 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>
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<td>Each term</td>
<td>2 terms</td>
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## Mandatory

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<tbody>
<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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<tr>
<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-110836</td>
<td>Mathematical Methods in Continuum Mechanics</td>
<td>4 CR</td>
<td>Böhlke</td>
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## Continuum Mechanics (E) (Election: )

<table>
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<th>Module Title</th>
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<tbody>
<tr>
<td>T-MACH-105320</td>
<td>Introduction to the Finite Element Method</td>
<td>3 CR</td>
<td>Böhlke, Langhoff</td>
</tr>
<tr>
<td>T-MACH-110362</td>
<td>Introduction to Computational Fluid Dynamics</td>
<td>3 CR</td>
<td>Frohnapfel, Stroh</td>
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<tr>
<td>T-MACH-110330</td>
<td>Tutorial Introduction to the Finite Element Method</td>
<td>1 CR</td>
<td>Böhlke, Langhoff</td>
</tr>
<tr>
<td>T-MACH-111033</td>
<td>Tutorial Introduction to Computational Fluid Dynamics</td>
<td>1 CR</td>
<td>Frohnapfel, Stroh</td>
</tr>
</tbody>
</table>

### Competence Certificate

See different bricks

### Prerequisites

None

### Competence Goal

After having finished this major field the students can

- list important concepts and models of continuum mechanics both for solids and fluids including field equations and boundary conditions
- apply these models in given problems
- apply methods of tensor algebra and tensor analysis in given problems of continuum mechanics
- classify the basic numerical tools and apply them in given problems of continuum mechanics

### Content

The comprehensive topic of the major field are the basics of continuum mechanics that the students acquire within the compulsory parts (8 credit points). Moreover, there is a supplementary area covering the corresponding numerical methods which the students can choose according to their interests.

### Workload

The work load is about 360 hours in the Bachelor of Science program, whereof the presence time is 125 h.

### Learning type

Lectures, tutorials, computer tutorial, consultation hours

### Literature

See different bricks
### 7.12 Module: Major Field: Energy Converting Engines [M-MACH-102838]

**Responsible:** Prof. Dr. Thomas Koch  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Specialization in 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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<tbody>
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<td>12</td>
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<td>Each term</td>
<td>2 terms</td>
<td>German</td>
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#### Energy Converting Engines (K) (Elective: at least 8 credits)

<table>
<thead>
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<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Grade</th>
<th>Responsible</th>
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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-105326</td>
<td>Hydraulic Fluid Machinery</td>
<td>8 CR</td>
<td>Pritz</td>
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<tr>
<td>T-MACH-105363</td>
<td>Thermal Turbomachines I</td>
<td>6 CR</td>
<td>Bauer</td>
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#### Energy Converting Engines (E) (Elective: at most 5 credits)

<table>
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<th>Grade</th>
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<tbody>
<tr>
<td>T-CIWVT-105780</td>
<td>Design of a Jet Engine Combustion Chamber</td>
<td>6 CR</td>
<td>Zarzalis</td>
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<tr>
<td>T-MACH-111623</td>
<td>Fuels and Lubricants for Engine Powertrains</td>
<td>4 CR</td>
<td>Kehrwald, Kubach</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-105515</td>
<td>Introduction to Numerical Fluid Dynamics</td>
<td>4 CR</td>
<td>Pritz</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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<td>T-MACH-102093</td>
<td>Fluid Power Systems</td>
<td>4 CR</td>
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<td>T-MACH-110816</td>
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<td>4 CR</td>
<td>Kubach</td>
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<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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<td>T-MACH-105213</td>
<td>Fundamentals of Combustion I</td>
<td>4 CR</td>
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<td>4 CR</td>
<td>Bykov, Maas</td>
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<td>T-MACH-105337</td>
<td>Engine Laboratory</td>
<td>4 CR</td>
<td>Wagner</td>
<td></td>
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<tr>
<td>T-MACH-111578</td>
<td>Sustainable Vehicle Drivetrains</td>
<td>4 CR</td>
<td>Koch, Toedter</td>
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<td>4 CR</td>
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<td>Thermal Turbomachines II</td>
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<td>Turbo Charging of Internal Combustion Engines</td>
<td>4 CR</td>
<td>Kech, Kubach</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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<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-113359</td>
<td>Boosting the Modern Energy Landscape via Turbo Machines &amp; Machine Learning</td>
<td>4 CR</td>
<td>Bauer</td>
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</table>

**Competence Certificate**  
Refer to different brick descriptions of SP24

**Prerequisites**  
None
**Competence Goal**
The students acquire broad and well-founded knowledge of the scientific theories, principles and methods of engines and work machines in the mandatory part of this major field. The aim is to design, apply and evaluate these machines.

Building on this, the students deepen selected fields of application in the election block, so that they are then able to independently analyze and evaluate problems from this field of application and to develop solutions based on this. After completing the specialization, students can in particular

- name the function and use of engines and working machines,
- describe the state of the art and the resulting fields of application of the engines and work machines and apply them using the example,
- name the basic theories, methods and properties for the various fields of application of the engines and work machines and use and evaluate them.

**Content**
Energy-converting machines are a core topic in mechanical engineering. This major field deals with the design and functioning of various energy-converting machines. Essentially, this involves hydraulic flow machines, thermal turbo machinery and internal combustion engines. In the election block, additional basics, sub-points and detailed questions of the above machines are treated. The spectrum ranges from basic numerical simulation of the processes to application-oriented project planning and system development.

**Workload**
The work load is 360 hours, corresponding to 12 credit points.

**Recommendation**
Recommended compulsory optional subject: Heat and mass transfer

**Learning type**
Lectures and Exercises
### 7.13 Module: Major Field: Engineering Design (SP 10) [M-MACH-102815]

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

**Part of:** Specialization in Mechanical Engineering (Major Field)

<table>
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<th>Duration</th>
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<td>2 terms</td>
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- **Engineering Design (K) (Election: at least 8 credits)**

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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-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>
<td>4 CR</td>
<td>Düser, Ott</td>
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- **Engineering Design (E) (Election: )**

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<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-112717</td>
<td>Dimensioning of Additive-Manufactured Polymer Structures at an Example from Medical Engineering</td>
<td>4 CR</td>
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<tr>
<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>CAE-Workshop</td>
<td>4 CR</td>
<td>Albers, Matthiesen</td>
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<td>T-MACH-108719</td>
<td>Designing with numerical methods in product development</td>
<td>4 CR</td>
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<td>T-MACH-108374</td>
<td>Vehicle Ergonomics</td>
<td>4 CR</td>
<td>Ehrhardt</td>
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<td>T-MACH-102105</td>
<td>Manufacturing Technology</td>
<td>8 CR</td>
<td>Schulze</td>
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<tr>
<td>T-MACH-100092</td>
<td>Automotive Engineering I</td>
<td>8 CR</td>
<td>Gauterin, Gießler</td>
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<td>T-MACH-102116</td>
<td>Fundamentals for Design of Motor-Vehicle Bodies I</td>
<td>2 CR</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-111389</td>
<td>Fundamentals in the Development of Commercial Vehicles</td>
<td>4 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>
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<td>Innovation2Business – Innovation Strategy in the Industrial Corporate Practice</td>
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<td>T-MACH-105188</td>
<td>Integrative Strategies in Production and Development of High Performance Cars</td>
<td>4 CR</td>
<td>Schlichtenmayer</td>
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<td>T-MACH-105330</td>
<td>Design with Plastics</td>
<td>4 CR</td>
<td>Liedel</td>
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<td>T-MACH-105231</td>
<td>Leadership and Management Development</td>
<td>4 CR</td>
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<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</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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<td>T-MACH-102107</td>
<td>Quality Management</td>
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<td>T-MACH-111888</td>
<td>Re:Invent - Revolutionary Business Models as the Basis for Product Innovations</td>
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<td>Safety Engineering</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>
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<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-105361</td>
<td>Technical Design in Product Development</td>
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<tr>
<td>T-MACH-102148</td>
<td>Gear Cutting Technology</td>
<td>4 CR</td>
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</table>
Prerequisites
None

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

Content
see courses of the SP10

Workload
The work load is about 360 hours, corresponding to 12 credit points.

Learning type
lectures
auditorium exercises
workshops
7.14 Module: Major Field: Fundamentals of Energy Technology [M-MACH-102816]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering  
Institute of Thermal Turbomachinery  
**Part of:** Specialization in Mechanical Engineering (Major Field)

<table>
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<th>Duration</th>
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**Mandatory**

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<tr>
<td>T-MACH-105220</td>
<td>Fundamentals of Energy Technology</td>
<td>8 CR</td>
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<td>Badea, Cheng</td>
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**Fundamentals of Energy Technology (K) (Election: )**

<table>
<thead>
<tr>
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<th>Module Name</th>
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<tbody>
<tr>
<td>T-MACH-105525</td>
<td>Introduction to Nuclear Energy</td>
<td>4 CR</td>
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<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-105326</td>
<td>Hydraulic Fluid Machinery</td>
<td>8 CR</td>
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**Fundamentals of Energy Technology (E) (Election: )**

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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-105151</td>
<td>Energy Efficient Intralogistic Systems</td>
<td>4 CR</td>
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<td>Kramer, Schöning</td>
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<tr>
<td>T-MACH-105557</td>
<td>Microenergy Technologies</td>
<td>4 CR</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>Gatti, Magagnato</td>
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<td>T-ETIT-101939</td>
<td>Photovoltaics</td>
<td>6 CR</td>
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<td>T-MACH-110984</td>
<td>Production Technology for E-Mobility</td>
<td>4 CR</td>
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<td>T-MACH-106493</td>
<td>Solar Thermal Energy Systems</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-105403</td>
<td>Flows and Heat Transfer in Energy Technology</td>
<td>4 CR</td>
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<td>Cheng</td>
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<tr>
<td>T-MACH-111382</td>
<td>Technical Acoustics</td>
<td>4 CR</td>
<td></td>
<td>Pantle, Walter</td>
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<tr>
<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-105225</td>
<td>Thermal Solar Energy</td>
<td>4 CR</td>
<td>N.N.</td>
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<tr>
<td>T-MACH-105234</td>
<td>Windpower</td>
<td>4 CR</td>
<td>Lewald</td>
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**Fundamentals of Energy Technology (P) (Election: at most 4 credits)**

<table>
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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-106707</td>
<td>Workshop on Computer-based Flow Measurement Techniques</td>
<td>4 CR</td>
<td>Bauer</td>
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</table>

**Competence Certificate**  
Oral exam

**Prerequisites**  
None

**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.
Content
Fundamentals of energy technology offers sound knowledge on the subject of energy conversion, storage and transport as well as the necessary thermodynamic principles. The topics covered include conventional, fossil-fired power plants, combined heat and power generation, nuclear energy, renewable energy sources such as solar energy, wind power and hydropower, as well as energy storage and grid integration. The election block offers opportunities for in-depth study of the listed energy conversion types as well as practical modules in which the fundamentals can be applied in practice. Furthermore, there is the possibility to extend the knowledge of the fundamentals and to get an insight into numerical methods of flow simulation. Progress and challenges of energy system transformation and the latest findings from energy research are also discussed.

Workload
360 hours

Learning type
Lectures, Tutorials
### 7.15 Module: Major Field: Information Management (SP 17) [M-MACH-102583]

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Specialization in Mechanical Engineering (Major Field)

<table>
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#### Information Management (K) (Election: at least 8 credits)

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<tr>
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<td>I4.0 Systems Platform</td>
<td>4 CR</td>
<td>Maier, Ovtcharova</td>
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<tr>
<td>T-MACH-105147</td>
<td>Product Lifecycle Management</td>
<td>4 CR</td>
<td>Ovtcharova</td>
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<tr>
<td>T-MACH-102083</td>
<td>Integrated Information Systems for Engineers</td>
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#### Information Management (E) (Election: )

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<td>CAE-Workshop</td>
<td>4 CR</td>
<td>Albers, Matthiesen</td>
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<tr>
<td>T-MACH-111283</td>
<td>Development Methods of Technical Systems</td>
<td>4 CR</td>
<td>Maier, Ovtcharova</td>
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<tr>
<td>T-MACH-102209</td>
<td>Information Engineering</td>
<td>3 CR</td>
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<tr>
<td>T-MACH-102128</td>
<td>Information Systems and Supply Chain Management</td>
<td>3 CR</td>
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<td>T-MACH-112882</td>
<td>Innovation2Business – Innovation Strategy in the Industrial Corporate Practice</td>
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<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-105442</td>
<td>Intellectual Property Rights and Strategies in Industrial Companies</td>
<td>4 CR</td>
<td>Düser, Zacharias</td>
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<td>T-MACH-102153</td>
<td>PLM-CAD Workshop</td>
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<td>T-MACH-102155</td>
<td>Product, Process and Resource Integration in the Automotive Industry</td>
<td>4 CR</td>
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<td>Sustainable Product Engineering</td>
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<td>Virtual Reality Practical Course</td>
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#### Information Management (P) (Election: at most 4 credits)

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<td>CATIA CAD Training Course</td>
<td>2 CR</td>
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<tr>
<td>T-MACH-102187</td>
<td>CAD-NX Training Course</td>
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</table>

**Competence Certificate**

Examination of other kind and oral and/or written examination: duration 2 hours.

**Prerequisites**

None

**Competence Goal**

The students should:

- understand the relevance of information management in product development in consideration of increasing product and process complexity.
- have basic knowledge in handling information, which is generated by product development activities along the lifecycle.

**Content**

Generation and management of information  
Architecture and functionality of information systems  
CAX-systems, Industry 4.0

**Workload**

360 hours

**Learning type**

Lectures, Tutorials
7.16 Module: Major Field: Information Technology [M-MACH-102817]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Specialization in Mechanical Engineering (Major Field)

**Credits:** 12

**Grading scale:** Grade to a tenth

**Recurrence:** Each term

**Duration:** 2 terms

**Language:** German/English

**Level:** 3

**Version:** 4

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

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

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<td>Computational Intelligence</td>
<td>4 CR</td>
<td>Meisenbacher, Mikut, 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>
<td>Knoop</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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<td>Measurement II</td>
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### Information Technology (E) (Election: at most 6 credits)

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<td>Automotive Vision</td>
<td>6 CR</td>
<td>Lauer, Stiller</td>
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<td>T-MACH-102128</td>
<td>Information Systems and Supply Chain Management</td>
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<td>Information Processing in Sensor Networks</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.

**Prerequisites**

none

**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.

**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 work load is about 360 hours, corresponding to 12 credit points.

Learning type
lecture, practical training, exercise, prakticat training in laboratory
### 7.17 Module: Major Field: Materials Science and Engineering (SP 26) [M-MACH-102819]

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Specialization in Mechanical Engineering (Major Field)

**Credits:** 12  
**Grading scale:** Grade to a tenth  
**Recurrence:** Each term  
**Duration:** 2 terms  
**Language:** German/English  
**Level:** 3  
**Version:** 8

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

#### Mandatory

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#### Materials Science and Engineering (E) (Election: )

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#### Materials Science and Engineering (Ü) (Election: )

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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 individual choice.
Prerequisites
None

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.

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 12 credit points in the bachelor’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. For the bachelor’s program, a reduced catalogue exists (see Studienplan).

Workload
The work load is about 360 hours in the Bachelor of Science program, whereof the presence time is 66 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.
### Mechatronics (K) (Election: at least 8 credits)

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<tr>
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### Mechatronics (E) (Election: at most 1 item)

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7 MODULES

Module: Major Field: Mechatronics (SP 31) [M-MACH-102820]

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Mechatronics (Ü) (Election: )

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**Competence Certificate**
Written exam and oral exam.

**Prerequisites**
none

**Competence Goal**
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.

**Content**
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.

**Workload**
The work load is about 360 hours, corresponding to 12 credit points.

**Learning type**
The contents of this major field are taught in form of lectures, exercises and practical experiences.
7.19 Module: Major Field: Modeling and Simulation in Dynamics (SP 61) [M-MACH-104430]

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Specialization in Mechanical Engineering (Major Field)

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**Modeling and Simulation in Dynamics (K) (Election: at least 8 credits)**

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<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-105209</td>
<td>Introduction to Multi-Body Dynamics</td>
<td>5 CR</td>
<td>Römer</td>
</tr>
<tr>
<td>T-MACH-105120</td>
<td>Machine Dynamics</td>
<td>5 CR</td>
<td>Proppe</td>
</tr>
<tr>
<td>T-MACH-105293</td>
<td>Mathematical Methods in Dynamics</td>
<td>6 CR</td>
<td>Proppe</td>
</tr>
<tr>
<td>T-MACH-105290</td>
<td>Vibration Theory</td>
<td>5 CR</td>
<td>Fidlin</td>
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</table>

**Modeling and Simulation in Dynamics (E) (Election: at most 5 credits)**

<table>
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<tbody>
<tr>
<td>T-MACH-111260</td>
<td>Dynamics of Electro-Mechanical Systems</td>
<td>5 CR</td>
<td>Altoé, Fidlin</td>
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<tr>
<td>T-MACH-105514</td>
<td>Experimental Dynamics</td>
<td>5 CR</td>
<td>Fidlin</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-105294</td>
<td>Mathematical Methods of Vibration Theory</td>
<td>6 CR</td>
<td>Fidlin, Römer</td>
</tr>
<tr>
<td>T-MACH-105349</td>
<td>Computational Dynamics</td>
<td>4 CR</td>
<td>Proppe</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-105172</td>
<td>Simulation of Coupled Systems</td>
<td>4 CR</td>
<td>Geimer</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>
</tr>
<tr>
<td>T-MACH-113412</td>
<td>Atomistic Simulations and Particle Dynamics</td>
<td>4 CR</td>
<td>Gumbsch, Schneider, Weygand</td>
</tr>
</tbody>
</table>

**Competence Certificate**

oral examination

**Prerequisites**

None

**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.

**Content**

This module deals with procedures, 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**

360 h

**Learning type**

Lectures, tutorials
### 7.20 Module: Major Field: Powertrain Systems (SP 02) [M-MACH-102812]

**Responsible:** Prof. Dr.-Ing. Albert Albers  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Specialization in 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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<td>Grade to a tenth</td>
<td>Each term</td>
<td>2 terms</td>
<td>German/English</td>
<td>3</td>
<td>5</td>
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</table>

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

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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</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>
</tr>
<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-105216</td>
<td>Powertrain Systems Technology B: Stationary Machinery</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Ott</td>
</tr>
<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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</table>

#### Powertrain Systems (E) (Election: )

<table>
<thead>
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<th>Course Title</th>
<th>Credits</th>
<th>Instructor(s)</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-105209</td>
<td>Introduction to Multi-Body Dynamics</td>
<td>5 CR</td>
<td>Römer</td>
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<tr>
<td>T-MACH-105151</td>
<td>Energy Efficient Intralogistic Systems</td>
<td>4 CR</td>
<td>Kramer, Schönung</td>
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<tr>
<td>T-ETIT-100784</td>
<td>Hybrid and Electric Vehicles</td>
<td>4 CR</td>
<td>Doppelbauer</td>
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<tr>
<td>T-MACH-112882</td>
<td>Innovation2Business – Innovation Strategy in the Industrial Corporate Practice</td>
<td>4 CR</td>
<td>Albers</td>
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<tr>
<td>T-MACH-105187</td>
<td>IT-Fundamentals of Logistics</td>
<td>4 CR</td>
<td>Thomas</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-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-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>Düser, 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</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>
<td>T-MACH-111821</td>
<td>Control of Mobile Machines</td>
<td>4 CR</td>
<td>Becker, Geimer</td>
</tr>
<tr>
<td>T-MACH-111820</td>
<td>Control of Mobile Machines – Prerequisites</td>
<td>0 CR</td>
<td>Becker, Geimer</td>
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<tr>
<td>T-MACH-105185</td>
<td>Control Technology</td>
<td>4 CR</td>
<td>Günntheimer</td>
</tr>
<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>
<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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<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>
<td>Klaiber</td>
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#### Powertrain Systems (Ü) (Election: )

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Instructor(s)</th>
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</thead>
<tbody>
<tr>
<td>T-MACH-109303</td>
<td>Exercises - Tribology</td>
<td>0 CR</td>
<td>Dienwiebel</td>
</tr>
</tbody>
</table>

This item will not influence the grade calculation of this parent.
Prerequisites
none

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.

Content
See courses of the SP02

Workload
The work load is about 360 hours, corresponding to 12 credit points.

Learning type
lectures
auditorium exercises
workshops
Module: Major Field: Production Systems (SP 38) [M-MACH-102589]

7.21 Module: Major Field: Production Systems (SP 38) [M-MACH-102589]

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

Part of: Specialization in Mechanical Engineering (Major Field)

<table>
<thead>
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<th>Credits</th>
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<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
<th>Level</th>
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<td>12</td>
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<td>Each term</td>
<td>2 terms</td>
<td>German</td>
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Production Systems (K) (Election: at least 8 credits)

<table>
<thead>
<tr>
<th>Code</th>
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<th>Instructor</th>
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<tbody>
<tr>
<td>T-MACH-105518</td>
<td>Human Factors Engineering I</td>
<td>4</td>
<td>Deml</td>
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<tr>
<td>T-MACH-105519</td>
<td>Human Factors Engineering II</td>
<td>4</td>
<td>Deml</td>
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<tr>
<td>T-MACH-102105</td>
<td>Manufacturing Technology</td>
<td>8</td>
<td>Schulze</td>
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<tr>
<td>T-MACH-108849</td>
<td>Integrated Production Planning in the Age of Industry 4.0</td>
<td>8</td>
<td>Lanza</td>
</tr>
<tr>
<td>T-MACH-110962</td>
<td>Machine Tools and High-Precision Manufacturing Systems</td>
<td>8</td>
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Production Systems (E) (Election: )

<table>
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<th>Instructor</th>
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<tbody>
<tr>
<td>T-MACH-108844</td>
<td>Automated Manufacturing Systems</td>
<td>8</td>
<td>Fleischer</td>
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<tr>
<td>T-MACH-105147</td>
<td>Product Lifecycle Management</td>
<td>4</td>
<td>Ovtcharova</td>
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<tr>
<td>T-MACH-102107</td>
<td>Quality Management</td>
<td>4</td>
<td>Lanza</td>
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<td>T-MACH-102083</td>
<td>Integrated Information Systems for Engineers</td>
<td>4</td>
<td>Ovtcharova</td>
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Production Systems (P) (Election: at most 4 credits)

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<tbody>
<tr>
<td>T-MACH-108878</td>
<td>Laboratory Production Metrology</td>
<td>4</td>
<td>Lanza, Stamer</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</td>
<td>Zanger</td>
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</tbody>
</table>

Competence Certificate

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

Prerequisites

None

Competence Goal

The students...

- are able to choose methods of production science target-oriented in familiar situations and are able to justify their selection.
- are able to describe and compare production processes exemplarily.
- are able to transfer known solutions to given problems 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 results of others at the solution of given problems.
- have the ability to present their own results in written form and are able to interpret them.
- 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.

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 360 hours, corresponding to 12 credit points.

Learning type

Lectures, seminars, workshops, excursions
7.22 Module: Major Field: Rail System Technology (SP 50) [M-MACH-102638]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Specialization in Mechanical Engineering (Major Field)

<table>
<thead>
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<th>Credits</th>
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<th>Duration</th>
<th>Language</th>
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**Mandatory**

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<th>Grading</th>
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<tr>
<td>T-MACH-106424</td>
<td>Rail System Technology</td>
<td>4 CR</td>
<td>Cichon</td>
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<tr>
<td>T-MACH-105353</td>
<td>Rail Vehicle Technology</td>
<td>4 CR</td>
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**Rail System Technology (E) (Election: )**

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<th>Course Title</th>
<th>Credits</th>
<th>Grading</th>
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<tbody>
<tr>
<td>T-MACH-105540</td>
<td>Railways in the Transportation Market</td>
<td>4 CR</td>
<td>Cichon</td>
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<tr>
<td>T-MACH-113016</td>
<td>Digitization in the Railway System</td>
<td>4 CR</td>
<td>Cichon</td>
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<tr>
<td>T-MACH-105237</td>
<td>Vehicle Lightweight Design - Strategies, Concepts, Materials</td>
<td>4 CR</td>
<td>Henning</td>
<td></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-113069</td>
<td>Vehicle Systems for Urban Mobility</td>
<td>4 CR</td>
<td>Cichon</td>
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<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-113068</td>
<td>Innovation and Project Management in Rail Vehicle Engineering</td>
<td>4 CR</td>
<td>Cichon</td>
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<td>Computational Vehicle Dynamics</td>
<td>4 CR</td>
<td>Proppe</td>
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<td>T-MACH-108692</td>
<td>Seminar for Rail System Technology</td>
<td>3 CR</td>
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**Competence Certificate**

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

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

**Prerequisites**

None

**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.
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: 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
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 12 ECTS (B.Sc.): about 360 hours
- Regular attendance: 63 hours
- Self-study: 63 hours
- Exam and preparation: 234 hours

Learning type

Lectures in the core part.

Lectures and seminars are offered in the supplementary part.
7.23 Module: Major Field: Technical Logistics (SP 44) [M-MACH-102821]

Responsibilities: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization in Mechanical Engineering (Major Field)

Credits: 12
Grading scale: Grade to a tenth
Recurrence: Each term
Duration: 2 terms
Language: German
Level: 3
Version: 5

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

<table>
<thead>
<tr>
<th>Technical Logistics (K) (Election: at least 8 credits)</th>
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</thead>
<tbody>
<tr>
<td>T-MACH-112113 Dynamic Systems of Technical Logistics</td>
</tr>
<tr>
<td>T-MACH-112841 Basics of Technical Logistics I</td>
</tr>
<tr>
<td>T-MACH-109920 Basics of Technical Logistics II</td>
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<table>
<thead>
<tr>
<th>Technical Logistics (E) (Election: )</th>
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<tbody>
<tr>
<td>T-MACH-112114 Dynamic Systems of Technical Logistics - Project</td>
</tr>
<tr>
<td>T-MACH-105174 Warehousing and Distribution Systems</td>
</tr>
<tr>
<td>T-MACH-105151 Energy Efficient Intralogistic Systems</td>
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<td>T-MACH-105175 Airport Logistics</td>
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<td>T-MACH-105187 IT-Fundamentals of Logistics</td>
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<td>T-MACH-105171 Safety Engineering</td>
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<td>T-MACH-102107 Quality Management</td>
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<td>T-MACH-108844 Automated Manufacturing Systems</td>
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<tr>
<td>T-MACH-105378 Cognitive Automobiles - Laboratory</td>
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<tr>
<td>T-MACH-105367 Behaviour Generation for Vehicles</td>
</tr>
</tbody>
</table>

Competence Certificate
Written and oral exams, see brick courses

Prerequisites
None

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 appropriate, and
- Evaluate resulting material handling installations.

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 workload is about 360 hours, corresponding to 12 credit points.

Learning type
Lectures and practices; self-study
### Module: Major Field: Vehicle Technology (SP 12) [M-MACH-102818]

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

**Part of:** Specialization in Mechanical Engineering (Major Field)

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### Competence Certificate

Valid for all degree programmes, for which no value is indicated in the following.

The assessment is carried out as partial exams of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module separately. Amount, type and scope of the success control can vary according to the individually choice. Oral exams: duration approx. 5 min. per credit point. Within the scope of lab courses maximum 4 credits may be acquired.

The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

### Prerequisites

None

### 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.

### Content

In the module Automotive Technology the basics are taught, which are important for the development, the design, the production and the operation of vehicles. Particularly the primary important aggregates like engine, gear, drive train, chassis and auxiliary equipment are explained, but also all technical equipment, which make the operation safer and easier. Additionally the interior equipment is examined, which shall provide a preferably comfortable, optimum ambience to the user.

In the module Automotive Technology the focus is on passenger cars and commercial vehicles, which are designed for road applications.

### Workload

The work load is about 360 hours, corresponding to 12 credit points.

### Learning type

The teaching and learning procedures (lecture, lab course, workshop) are described for each course of the module separately.
7.25 Module: Major Field: Vibration Theory [M-MACH-104442]

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**Vibration Theory (K) (Election: at least 8 credits)**

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<td>Introduction to Nonlinear Vibrations</td>
<td>7 CR</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-105294</td>
<td>Mathematical Methods of Vibration Theory</td>
<td>6 CR</td>
<td>Fidlin, Römer</td>
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<td>T-MACH-105372</td>
<td>Theory of Stability</td>
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<td>T-MACH-105290</td>
<td>Vibration Theory</td>
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**Vibration Theory (E) (Election: at most 4 credits)**

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<td>T-MACH-111260</td>
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<td>T-MACH-105349</td>
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<td>T-MACH-105373</td>
<td>Practical Training in Measurement of Vibrations</td>
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**Competence Certificate**

oral examination

**Prerequisites**

None

**Content**

The students know different methods which may be applied for the analysis of investigation of vibration problems. They are able to treat one or multiple degree 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.
Module: Manufacturing Processes [M-MACH-102549]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Fundamentals of Engineering

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**Competence Certificate**

written exam (duration: 60 min)

**Prerequisite**

none

**Competence Goal**

The students ...

- are able to classify the manufacturing processes by their general functionality according to the specific main groups (DIN 8580).
- have the ability to declare and explain the function of the significant manufacturing processes of the main groups (DIN 8580).
- are enabled to describe the characteristic process features (geometry, materials, accuracy, tools, machines) of the significant manufacturing processes of the main groups (DIN 8580).
- have the ability to derive the relevant process specific technical advantages and disadvantages of the characteristic process features.
- are enabled to perform a selection of suitable manufacturing processes for given components.
- are enabled to classify the required manufacturing processes in the expiry of a process chain for the production of given sample products.

**Content**

The objective of the lecture is to classify the manufacturing technology within the wider context of production engineering, to provide an overview of the different manufacturing processes and to establish basic process knowledge of the common processes. The lecture conveys the basic principles of manufacturing technology and deals with the manufacturing processes based on example components according to their classification into main groups regarding technical and economic aspects.

The following topics will be covered:

- Primary processing (casting, plastics engineering, sintering, additive manufacturing processes)
- Forming (sheet-metal forming, massive forming)
- Cutting (machining with geometrically defined and geometrically undefined cutting edges, separating, abrading)
- Joining
- Coating
- Heat treatment and surface treatment

**Workload**

regular attendance: 21 hours
self-study: 99 hours

**Learning type**

Lecture
Module: Materials Science (BSc-Modul 04, WK) [M-MACH-102562]

**7.27 Module: Materials Science (BSc-Modul 04, WK) [M-MACH-102562]**

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Fundamentals of Engineering

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**Competence Certificate**

not graded: participation in 10 lab experiments, introductory colloquia must be passed and 1 short presentation must be presented. The lab course must be finished successfully prior to the registration for the oral exam;

graded: oral exam covering the whole module, about 25 minutes.

**Prerequisites**

none

**Competence Goal**

Within this Module the students should

- gain knowledge of basics about structural and functional materials
- be able to draw relationships between atomic structure, microstructure and properties
- be able to apply appropriate methods to determine mechanical and other relevant properties as well as to characterize the microstructure of materials
- be able to assess material properties and corresponding applications

**Content**

**WK I**

Structure of atoms and atomic bonding

Crystalline solids

Defects in crystalline solids

Amorphous and partially crystalline solids

Constitution of alloys and materials

Diffusion and phase transformation in the solid state

Microscopic characterization method

Characterization with X-Rays and neutrons

Non-destructive Testing

Mechanical Testing

**WK II**

Iron based alloys

Non-iron based alloys

Ceramics

Glasses

Polymers

Composite Materials

**Annotation**

For the Bachelor's program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.

For the Bachelor's program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.
Workload
The workload of the module is about 420 hours.

The workload for the lab course Materials Science is 90 h in total and consists of the presence during the 10 experiments (one week half-time, 4 hours per day) as well as preparation and rework time at home.

The workload for the lecture Materials Science I & II is 165 h per semester and consists of the presence during the lectures (WS: 4 SWS, SS: 2SWS) and the exercises (1 SWS per WS and 1 SWS per SS) as well as preparation and rework time at home.

Learning type
The module "Materials Science" consists of the lectures "Materials Science I and II" with additional tutorials for small groups and a one week materials science laboratory course.
Module: Measurement and Control Systems (BSc-Modul 11, MRT) [M-MACH-102564]

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

Part of: Fundamentals of Engineering

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| T-MACH-104745 | Basics in Measurement and Control Systems | 7 CR | Stiller |

Competence Certificate
Type of Examination: written exam
Duration of Examination: 150 minutes
Prerequisites
none

Competence Goal

- Students are able to name, describe and explain control principles applied to physical quantities.
- They are able to name, analyze and assess system theoretic characteristics of dynamical systems.
- Students are able to represent real systems in a system theoretic model and to assess the suitability of a given model.
- Students are able to apply methods for controller design and to analyze their properties.
- Students are able to select appropriate principles of metrology and to model, analyze and assess measurement setups.
- Students are able to quantify and assess measurement uncertainties.

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

Module grade calculation
result of exam

Annotation
For the Bachelor's program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.
For the Bachelor's program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

Workload
84 hours presence time, 126 hours selfstudies

Recommendation
Fundamentals in physics and electrical engineering, ordinary linear differential equations, Laplace transform

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

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

- Regelungstechnische Bücher:
  J. Lunze: Regelungstechnik 1 & 2, Springer-Verlag
  R. Unbehauen: Regelungstechnik 1 & 2, Vieweg-Verlag
  O. Föllinger: Regelungstechnik, Hüthig-Verlag
  W. Leonhard: Einführung in die Regelungstechnik, Teubner-Verlag

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

Measurement and Control Systems
Module: Mechanical Design (BSc-Modul 06, MKL) [M-MACH-102573]

_Responsibility:_ Prof. Dr.-Ing. Sven Matthiesen  
_Organisation:_ KIT Department of Mechanical Engineering  
_Part of:_ Fundamentals of Engineering

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<td>Mechanical Design I, Prerequisites</td>
<td>1 CR</td>
<td>Matthiesen</td>
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<td>T-MACH-105283</td>
<td>Mechanical Design II, Prerequisites</td>
<td>1 CR</td>
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<tr>
<td>T-MACH-110955</td>
<td>Mechanical Design III, Tutorial</td>
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<td>T-MACH-110956</td>
<td>Mechanical Design IV, Tutorial</td>
<td>1 CR</td>
<td>Matthiesen</td>
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</table>

**Competence Certificate**

**Mechanical Design I and II:**

Preliminary examination: Successful participation in workshops in the field of mechanical Design I, as well as successful processing of output power in mechanical Design II  
Written examination in the field of mechanical engineering I and II: duration 90 min plus reading time

**Mechanical Design III and IV:**

Preliminary examination: Successful participation in workshops in the field of mechanical Design III & IV  
- Examination in the field of mechanical Design III & IV consisting of written part with duration 60 min plus reading time and  
- constructive part with duration 180 min plus reading time

**Prerequisites**

None

**Competence Goal**

In mechanical design, students acquire skills in analysis and synthesis using examples (= leading examples). The examples include individual machine elements such as bearings or springs as well as more complex systems such as gears or clutches. After completing the machine design course, the students can apply the learned contents to further technical systems - even those not known from the lecture - by transferring the exemplary learned operating principles and basic functions to other contexts. This enables students to independently analyze unknown technical systems and to synthesize systems suitable for given problems.
Content
MKL I:
- Introduction to product development
- Springs
- Tools for visualization (technical drawing)
- Technical systems
- Bearings and guides

MKL II:
- Basics of the design
- Basics of screw connections
- Basics Seals

MKL III:
- Component connections
- Tolerances and clearance
- Transmission

MKL IV:
- Clutches
- Fluid Technology
- Dimensioning
- Electrical machines

Annotation
For the Bachelor’s program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.

For the Bachelor’s program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.
Workload

MKL 1:

Presence: 33.5 h
Attendance in lectures: $15 \times 1.5 \text{ h} = 22.5 \text{ h}$
Presence in exercises: $8 \times 1.5 \text{ h} = 12 \text{ h}$

Self-study: 56.5 h
Personal preparation and wrap-up of lecture and exercises including the processing of the test certificates and preparation for the exam: 56.5 h
Total: 90 h = 3 LP

MKL 2:

Presence: 33 h
Attendance in lectures: $15 \times 1.5 \text{ h} = 22.5 \text{ h}$
Presence in exercises: $7 \times 1.5 \text{ h} = 10.5 \text{ h}$

Self study: 87 h
Personal preparation and wrap-up of lectures and exercises, including the processing of the test certificates and preparation for the exam: 87 h
Total: 120 h = 4 LP

MKL 3:

Presence: 45 h
Attendance lectures (15 L): 22.5h
Presence exercises (7 exercises): 10.5h
Attendance milestones project work (3x 4h): 12h

Self-study: 135h
Project work in a team: 90h
Personal preparation and follow-up of lecture and exercise: 45 h
Total: 180 h = 6 LP

MKL 4:

Presence: 40.5h
Attendance lectures (13 L): 19.5h
Presence exercises (6 exercises): 9h
Attendance milestones project work (3x 4h): 12h

Self-study: 169.5h
Project work in a team: 105h
Personal preparation and follow-up of lecture and exercise, incl. preparation for the exam: 64.5h
Total: 210 h = 7 LP

Learning type
Lecture
Tutorial
Project work during the semester
## 7.30 Module: Orientation Exam [M-MACH-104624]

**Organisation:** University  
**Part of:** Orientation Exam

<table>
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<th>Duration</th>
<th>Language</th>
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<td>Arens, Griesmaier, Hettlich</td>
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<td>T-MACH-100282</td>
<td>Engineering Mechanics I</td>
<td>7 CR</td>
<td>Böhlke, Langhoff</td>
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<td>T-MACH-100283</td>
<td>Engineering Mechanics II</td>
<td>6 CR</td>
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</table>

**Modelled deadline**

This module must be passed until the end of the 3. term.
Module: Physics [M-PHYS-104030]

Responsible: apl. Prof. Dr. Gernot Goll
apl. Prof. Dr. Bernd Pilawa

Organisation: KIT Department of Physics

Part of: Fundamentals of Engineering

<table>
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<td>T-PHYS-108322</td>
<td>Wave and Quantum Physics</td>
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Competence Certificate
The assessment consists of a written exam according to Section 4(2). 1 of the examination regulation.

Prerequisites
None

Competence Goal
The students

- are familiar with the properties of waves and can discuss those
- can reflect on the principles of relativity
- comprehend the coherence of the particle and wave description of light and matter
- can explain the limits of wave physics
- are able to apply the Schrödinger-equation to basic problems in quantum mechanics
- can explain the basic properties of atoms, especially for the hydrogen atom
- can discuss fundamental aspects of the electronic properties of solids

Content

- Properties of waves
- Acoustic and electromagnetic waves
- Interference and diffraction
- Relativity
- Wave-particle dualism
- Basic properties of atoms
- Basic electronic properties of solids

Annotation
For the Bachelor’s program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.

For the Bachelor’s program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

Workload
150 hours, consisting of attendance times (45), follow-up of the lecture including exam preparation and preparation of exercises (105)

Learning type
Lecture and Tutorial
7.32 Module: Supplementary Studies on Culture and Society [M-ZAK-106235]

**Responsible:** Dr. Christine Mielke  
Christine Myglas

**Organisation:**

**Part of:** Additional Examinations (Usage from 4/1/2023)

<table>
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**Election notes**

With the exception of the final oral exam and the practice module, students have to self-record the achievements obtained in the Supplementary Studies on Culture and Society in their study plan. ZAK records the achievements as "non-assigned" under "ÜQ/SQ-Leistungen". Further instructions on self-recording of achievements can be found in the FAQ at https://campus.studium.kit.edu/ and on the ZAK homepage at https://www.zak.kit.edu/begleitstudium-bak.php. The title of the examination and the amount of credits override the modules placeholders.

If you want to use ZAK achievements **both for your interdisciplinary qualifications and for the supplementary studies**, please record them in the interdisciplinary qualifications first. You can then get in contact with the ZAK study services (stg@zak.kit.edu) to also record them in your supplementary studies.

In the in-depth module, achievements have to be obtained in three different areas. The areas are as follows:

- Technology & Responsibility
- Doing Culture
- Media & Aesthetics
- Spheres of Life
- Global Cultures

You have to obtain two achievements with 3 credits each and one achievement with 5 credits. To self-record achievements in the in-depth module, you first have to elect the matching partial achievement.

**Note:** If you registered for the Supplementary Studies on Sustainable Development before April 1st, 2023, self-recording an achievement in this module counts as a request in the sense of §20 (2) of the regulations for the Supplementary Studies on Culture and Society. Your overall grade for the supplementary studies will thus be calculated as the average of the examination grades, not as the average of the module grades.

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<td>T-ZAK-112660</td>
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<td>T-ZAK-112659</td>
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**Competence Certificate**

The monitoring is explained in the respective partial achievement.

They are composed of:

- minutes
- presentations
- a seminar paper
- an internship report
- an oral examination

After successful completion of the supplementary studies, the graduates receive a graded certificate and a KIT certificate.
Prerequisites
The offer is study-accompanying and does not have to be completed within a defined period of time. Enrolment or acceptance for graduation must be present when registering for the final examination.

KIT students register for the supplementary studies by selecting this module in the student portal and self-checking a performance. In addition, registration for the individual courses is necessary, which is possible shortly before the beginning of each semester.

The course catalogue, statutes (study regulations), registration form for the oral exam, and guides for preparing the various written performance requirements can be found as downloads on the ZAK homepage at www.zak.kit.edu/begleitstudium-bak.

Competence Goal
Graduates of the Supplementary Studies on Culture and Society demonstrate a sound basic knowledge of conditions, procedures and concepts for analysing and shaping fundamental social development tasks in connection with cultural topics. They have gained a well-founded theoretical and practical insight into various cultural studies and interdisciplinary topics in the field of tension between culture, technology and society in the sense of an expanded concept of culture.

They are able to place the contents selected from the specialization module in the basic context as well as to analyse and evaluate the contents of the selected courses independently and exemplarily and to communicate about them scientifically in written and oral form. Graduates are able to analyse social topics and problem areas and critically reflect on them in a socially responsible and sustainable perspective.

Content
The Supplementary Studies on Culture and Society can be started from the 1st semester and is not limited in time. It comprises at least 3 semesters. The supplementary studies are divided into 3 modules (basics, in-depth studies, practice). A total of 22 credit points (ECTS) are earned.

The thematic elective areas of the supplementary studies are divided into the following 5 modules and their sub-topics:

Block 1: Technology & Responsibility
Value change / ethics of responsibility, technology development / history of technology, general ecology, sustainability

Block 2: Doing Culture
Cultural studies, cultural management, creative industries, cultural institutions, cultural policy

Block 3: Media & Aesthetics
Media communication, cultural aesthetics

Block 4: Spheres of Life
Cultural sociology, cultural heritage, architecture and urban planning, industrial science

Block 5: Global Cultures
Multiculturalism / interculturalism / transculturalism, science and culture

Module grade calculation
The overall grade of the supplementary studies is calculated as an average of the grades of the examination performances weighted with credit points.

In-depth Module
• presentation 1 (3 ECTS)
• presentation 2 (3 ECTS)
• seminar paper incl. presentation (5 ECTS)
• oral examination (4 ECTS)

Annotation
With the Supplementary Studies on Culture and Society, KIT provides a multidisciplinary study offer as an additional qualification, with which the respective specialized study program is supplemented by interdisciplinary basic knowledge and interdisciplinary orientation knowledge in the field of cultural studies, which is becoming increasingly important for all professions.

Within the framework of the supplementary studies, students acquire in-depth knowledge of various cultural studies and interdisciplinary subject areas in the field of tension between culture, technology and society. In addition to high culture in the classical sense, other cultural practices, common values and norms as well as historical perspectives of cultural developments and influences are considered.

In the courses, conditions, procedures and concepts for the analysis and design of fundamental social development tasks are acquired on the basis of an expanded concept of culture. This includes everything created by humans - also opinions, ideas, religious or other beliefs. The aim is to develop a modern concept of cultural diversity. This includes the cultural dimension of education, science and communication as well as the preservation of cultural heritage. (UNESCO, 1982)

According to § 16 of the statutes, a reference and a certificate are issued by the ZAK for the supplementary studies. The achievements are also shown in the transcript of records of the degree program and, upon request, in the certificate. They can also be recognized in the interdisciplinary qualifications (see elective information).
Workload
The workload is made up of the recommended number of hours for the individual modules:

- basic module approx. 90 h
- in-depth module approx. 340 h
- practical module approx. 120 h

Total: approx. 550 h

Learning type
- lectures
- seminars
- workshops
- practical course

Literature
Recommended reading of primary and specialized literature will be determined individually by each instructor.
7.33 Module: Supplementary Studies on Sustainable Development [M-ZAK-106099]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**
Part of: Additional Examinations (Usage from 4/1/2023)

**Credits** | **Grading scale** | **Recurrence** | **Duration** | **Language** | **Level** | **Version**
---|---|---|---|---|---|---
19 | Grade to a tenth | Each term | 3 terms | German | 3 | 1

**Election notes**
With the exception of the final oral exam, students have to self-record the achievements obtained in the Supplementary Studies on Sustainable Development in their study plan. ZAK records the achievements as "non-assigned" under "ÜQ/SQ-Leistungen". Further instructions on self-recording of achievements can be found in the FAQ at https://campus.studium.kit.edu/ and on the ZAK homepage at https://www.zak.kit.edu/begleitstudium-bene. The title of the examination and the amount of credits override the modules place holders.

If you want to use ZAK achievements both for your interdisciplinary qualifications and for the supplementary studies, please record them in the interdisciplinary qualifications first. You can then get in contact with the ZAK study services (stg@zak.kit.edu) to also record them in your supplementary studies.

In the elective module, you need to obtain 6 credits worth of achievements in two of the four areas:

- Sustainable Cities & Neighbourhoods
- Sustainable Assessment of Technology
- Subject, Body, Individual: The Other Side of Sustainability
- Sustainability in Culture, Economy & Society

Usually, two achievements with 3 credits each have to be obtained. To self-record achievements in the elective module, you first have to elect the matching partial achievement.

**Note:** If you registered for the Supplementary Studies on Sustainable Development before April 1st, 2023, self-recording an achievement in this module counts as a request in the sense of §19 (2) of the regulations for the Supplementary Studies on Sustainable Development. Your overall grade for the supplementary studies will thus be calculated as the average of the examination grades, not as the average of the module grades.

### Mandatory

| T-ZAK-112345 | Basics Module - Self Assignment BeNe | 3 CR | Myglas |

### Elective Module (Elective: at least 6 credits)

| T-ZAK-112347 | Elective Module - Sustainable Cities and Neighbourhoods - Self Assignment BeNe | 3 CR |
| T-ZAK-112348 | Elective Module - Sustainability Assessment of Technology - Self Assignment BeNe | 3 CR |
| T-ZAK-112349 | Elective Module - Subject, Body, Individual: The Other Side of Sustainability - Self Assignment BeNe | 3 CR |
| T-ZAK-112350 | Elective Module - Sustainability in Culture, Economy and Society - Self Assignment BeNe | 3 CR |

### Mandatory

| T-ZAK-112346 | Specialisation Module - Self Assignment BeNe | 6 CR | Myglas |
| T-ZAK-112351 | Oral Exam - Supplementary Studies on Sustainable Development | 4 CR |

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

They are composed of:

- protocols
- a reflection report
- presentations
- presentations
- the elaboration of a project work
- an individual term paper

Upon successful completion of the supplementary studies, graduates receive a graded report and a certificate issued by ZAK.
Prerequisites
The course is offered during the course of study and does not have to be completed within a defined period of time. Enrolment is required for all performance assessments of the modules of the supplementary studies. Participation in the supplementary studies is regulated by § 3 of the statutes.

KIT students register for the supplementary studies by selecting this module in the student portal and self-booking a performance. Registration for courses, performance assessments and examinations is regulated by § 6 of the Statutes and is usually possible shortly before the beginning of the semester.

The course catalogue, statutes (study regulations), registration form for the oral exam and guidelines for preparing the various written performance requirements can be found as downloads on the ZAK homepage at http://www.zak.kit.edu/begleitstudium-bene.

Competence Goal
Graduates of the supplementary studies in sustainable development acquire additional practical and professional competencies. Thus, the supplementary study program enables the acquisition of basics and initial experience in project management, trains teamwork skills, presentation skills and self-reflection, and also creates a fundamental understanding of sustainability that is relevant for all professional fields.

Graduates are able to analyse social topics and problem areas and critically reflect on them in a socially responsible and sustainable perspective. They are able to place the contents selected from the modules “Elective” and “Advanced” in the basic context as well as to independently and exemplarily analyse and evaluate the contents of the selected courses and to scientifically communicate about them in written and oral form.

Content
The supplementary study program Sustainable Development can be started from the 1st semester and is not limited in time. The wide range of courses offered by ZAK makes it possible to complete the program usually within three semesters. The supplementary studies comprise 19 credit points (LP). It consists of three modules: Basic Module, Elective Module and Advanced Module.

The thematic elective areas of the supplementary studies are divided into the following 4 modules and their subtopics in Module 2 (elective module):

Block 1 Sustainable Cities and Neighbourhoods
The courses provide an overview of the interaction of social, ecological, and economic dynamics in the microcosm of the city.

Block 2 Sustainability Assessment of Technology
Mostly based on ongoing research activities, methods and approaches of technology assessment are elaborated.

Block 3 Subject, Body, Individual: The other Side of Sustainability
Different approaches are presented to the individual perception, experience, shaping and responsibility of relationships to the environment and to oneself.

Block 4 Sustainability in Culture, Economy & Society
Courses usually have an interdisciplinary approach, but may also focus on one of the areas of culture, economics or society, both in application and in theory.

The core of the supplementary studies is a case study in the specialization area. In this project seminar, students conduct sustainability research with practical relevance themselves. The case study is supplemented by an oral examination with two topics from module 2 (elective module) and module 3 (in-depth module).

Module grade calculation
The overall grade of the supplementary studies is calculated as an average of the grades of the examination performances weighted with credit points.

Elective module
- Presentation 1 (3 ECTS)
- Presentation 2 (3 ECTS)

Advanced module
- individual term paper (6 ECTS)
- oral examination (4 ECTS)
Annotation
The Supplementary Studies on Sustainable Development at KIT is based on the conviction that a long-term socially and ecologically compatible coexistence in the global world is only possible if knowledge about necessary changes in science, economy and society is acquired and applied.

The interdisciplinary and transdisciplinary Studies on Sustainable Development enables diverse access to transformation knowledge as well as basic principles and application areas of sustainable development. According to the statutes § 16, a certificate is issued by the ZAK for the complementary studies.

The achievements are also shown in the transcript of records of the degree program and, upon request, in the certificate. They can also be recognized in the interdisciplinary qualifications (see elective information).

In the specialised studies, modules and partial achievements can be recognised within the framework of the additional achievements or e.g. the interdisciplinary qualifications. This must be regulated via the respective subject study programme.

The focus is on experience- and application-oriented knowledge and competences, but theories and methods are also learned. The aim is to be able to represent one's own actions as a student, researcher and later decision-maker as well as an individual and part of society under the aspect of sustainability.

Sustainability is understood as a guiding principle to which economic, scientific, social and individual actions should be oriented. According to this, the long-term and socially just use of natural resources and the material environment for a positive development of global society can only be addressed by means of integrative concepts. Therefore, "education for sustainable development" in the sense of the United Nations programme plays just as central a role as the goal of promoting "cultures of sustainability". For this purpose, practice-centred and research-based learning of sustainability is made possible and the broad concept of culture established at ZAK is used, which understands culture as habitual behaviour, lifestyle and changing context for social actions.

The supplementary study programme conveys the basics of project management, trains teamwork skills, presentation skills and self-reflection. Complementary to the specialised studies at KIT, it creates a fundamental understanding of sustainability, which is important for all professional fields. Integrative concepts and methods are essential: in order to use natural resources in the long term and to shape the global future in a socially just way, not only different disciplines, but also citizens, practitioners and institutions must work together.

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

- Basic module approx. 180 h
- Elective module approx. 150 h
- Consolidation module approx. 180 h

Total: approx. 510 h

Learning type
- lectures
- seminars
- workshops

Literature
Recommended reading of primary and specialist literature is determined individually by the respective lecturer.
Module: Sustainable Production Economics (BSc-Modul 22 MWT) [M-MACH-105902]

Responsible: Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Gisela Lanza

Organisation: KIT Department of Mechanical Engineering
Part of: Fundamentals of Engineering (Usage from 10/1/2022)

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<th>Level</th>
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Mandatory

T-MACH-111859 Sustainable Production Economics 5 CR Furmans, Lanza

Competence Certificate
Written Exam (90 minutes)

Prerequisites
none

Competence Goal
After successful completion of the course, the students are able …

- to discuss, alone and in a team, the terms, contexts and models by which manufacturing companies are described;
- to discuss typical problems of manufacturing companies, especially against the background of current and future challenges of ecological, social and economic sustainability;
- to apply the most important methods for efficient and sustainable management in industrial enterprises, in particular in the sense of the circular economy, in a problem-related manner;
- to select and justify decision-making alternatives by applying the methods learned;
- to critically question the methods learned and to independently acquire methods that go beyond this.

Content
The module conveys an overall understanding of operational production management with special consideration of aspects of sustainability as well as an application-oriented understanding of the fundamental issues and methods in industrial companies. Through exercises as well as a business game synchronous to the lecture, the taught contents are deepened through application, so that the participants can apply them directly in their later professional environment.

Annotation
It is a joint module of the Institute of Materials Handling and Logistics (IFL) and the Institute of Production Science (WBK).
For the Bachelor’s program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.
For the Bachelor’s program Mechanical Engineering (International) a comparable module with comparable courses is offered in English.

Workload
Regular attendance: 42 hours
Self-study: 108 hours

Learning type
1. Lectures (Obligatory)
2. Tutorials (Obligatory)
Module: Technical Thermodynamics (BSc-Modul 05, TTD) [M-MACH-102574]

7.35 Module: Technical Thermodynamics (BSc-Modul 05, TTD) [M-MACH-102574]

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

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<td>2 terms</td>
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Mandatory

- **T-MACH-104747** Technical Thermodynamics and Heat Transfer I 8 CR Maas
- **T-MACH-105287** Technical Thermodynamics and Heat Transfer II 7 CR Maas
- **T-MACH-105204** Excercises in Technical Thermodynamics and Heat Transfer I 0 CR Maas
- **T-MACH-105288** Excercises in Technical Thermodynamics and Heat Transfer II 0 CR Maas

Competence Certificate
See individual courses

Prerequisites
None

Competence Goal
The students acquire the competency to master the fundamentals of thermodynamics and the ability to apply this knowledge to problem-solving in various branches of mechanical engineering and especially in the energy technology sector.

An integral part of the module is that students can define the fundamental laws of thermodynamics and their applications. The students are competent in describing and comparing the main processes in energy conversion that are important in mechanical engineering. Using tools also applied in industry, they are capable of analyzing and rating the efficiency of processes. The students are capable of discussing the thermodynamic correlation of ideal gas mixtures, real gases, and humid air, as well as explaining the properties on a molecular basis and analyzing them with the help of the laws of thermodynamics. Furthermore, the students are capable of explaining chemical reactions in the context of thermodynamics as well as defining and applying the heat transfer mechanisms.

Content
Thermodynamics I:
- System, properties of state
- Absolute temperature, model systems
- 1st law of thermodynamics for resting and moving systems
- Entropy and 2nd law of thermodynamics
- Behavior of real substances described by tables, diagrams and equations of state
- Machine processes
- Mixtures of ideal and real compounds

Thermodynamics II:
- Repetition of the topics of "Thermodynamics and Heat Transfer I"
- Behavior of mixtures
- Moist air
- Kinetic theory of gases
- Behavior of real substances described by equations of state
- Chemical reactions and applications of the laws of thermodynamics to chemical reactions
- Reaction kinetics
- Heat Transfer

Module grade calculation
weight according to CP
**Annotation**
For the Bachelor's program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.
For the Bachelor's program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

**Workload**
lectures and exercises: 150h
homework and preparation of examination: 300h

**Learning type**
Lecture
Exercise course
Tutorial
8 Courses

8.1 Course: Advanced Mathematics I [T-MATH-100275]

**Responsible:**
PD Dr. Tilo Arens  
Prof. Dr. Roland Griesmaier  
PD Dr. Frank Hettlich

**Organisation:**
KIT Department of Mathematics

**Part of:**
M-MACH-104624 - Orientation Exam  
M-MATH-102859 - Advanced Mathematics

<table>
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**Events**

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<td>Höhere Mathematik I für die Fachrichtung Maschinenbau, Geodäsie, Materialwissenschaft und Werkstofftechnik</td>
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<td>Hettlich</td>
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**Exams**

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<td>6700007</td>
<td>Advanced Mathematics I</td>
<td>Arens, Griesmaier, Hettlich</td>
</tr>
</tbody>
</table>

**Competence Certificate**

Learning assessment is carried out by written examination of 120 minutes length.

**Prerequisites**

A "pass" result on the pre-requisite in AM I is a requirement for registration for the examination in AM I.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MATH-100525 - Tutorial Advanced Mathematics I must have been passed.
8.2 Course: Advanced Mathematics II [T-MATH-100276]

- **Responsible:** PD Dr. Tilo Arens, Prof. Dr. Roland Griesmaier, PD Dr. Frank Hettlich
- **Organisation:** KIT Department of Mathematics
- **Part of:** M-MATH-102859 - Advanced Mathematics

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**Exams**

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**Competence Certificate**
Learning assessment is carried out by written examination of 120 minutes length.

**Prerequisites**
A "pass" result on the pre-requisite in AM II is a requirement for registration for the examination in AM II.

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

1. The course T-MATH-100526 - Tutorial Advanced Mathematics II must have been passed.
### 8.3 Course: Advanced Mathematics III [T-MATH-100277]

**Responsible:**
- PD Dr. Tilo Arens
- Prof. Dr. Roland Griesmaier
- PD Dr. Frank Hettlich

**Organisation:**
- KIT Department of Mathematics

**Part of:**
- M-MATH-102859 - Advanced Mathematics

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<td>Höhere Mathematik III für die Fachrichtungen Maschinenbau, Chemieingenieurwesen, Verfahrenstechnik, Bioingenieurwesen und das Lehramt Maschinenbau</td>
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<td>Advanced Mathematics III</td>
<td>Arens, Griesmaier, Hettlich</td>
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</table>
Course: Airport Logistics [T-MACH-105175]

Responsibility: Dr.-Ing. André Richter
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102821 - Major Field: Technical Logistics

**Type**
Oral examination

**Credits**
3

**Grading scale**
Grade to a third

**Recurrence**
Each winter term

**Version**
2

### Events

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### Exams

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<td>Oral examination</td>
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**Competence Certificate**
The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

**Prerequisites**
none

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

**Airport logistics**

2117056, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**

**On-Site**

**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 informations 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**

Termine: siehe ILIAS.
Literature
8 COURSES

Course: Alternative Powertrain for Automobiles [T-MACH-105655]

8.5 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-102818 - Major Field: Vehicle Technology

<table>
<thead>
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Exams

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<th>Sustainable Vehicle Drivetrains</th>
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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 23/24, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Sustainability
Environmental balance
Legislation
Alternative fuels
BEV
Fuel cell
Hybrid drives
8.6 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-102645 - Major Field: Combustion Engine Techniques

<table>
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Events

| ST 2024 | 2134150 | Gas, lubricating oil and operating media analysis in drive train development | 2 SWS | Lecture / 🗣 | Gohl |

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:

Gas, lubricating oil and operating media analysis in drive train development 2134150, SS 2024, 2 SWS, Language: German, Open in study portal

Literature
Die Vorlesungsunterlagen werden vor jeder Veranstaltung an die Studenten verteilt.
8.7 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-102812 - Major Field: Powertrain Systems
- M-MACH-102815 - Major Field: Engineering Design

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<td>Each winter term</td>
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**Competence Certificate**
oral exam (20 min)

**Prerequisites**
None
Course: Atomistic Simulations and Particle Dynamics [T-MACH-113412]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102819 - Major Field: Materials Science and Engineering  
M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics

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

**Prerequisites**  
none

**Recommendation**  
preliminary knowledge in mathematics, physics and materials science
8.9 Course: Automated Manufacturing Systems [T-MACH-108844]

**Responsible:** Prof. Dr.-Ing. Jürgen Fleischer  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102589 - Major Field: Production Systems  
- M-MACH-102818 - Major Field: Vehicle Technology  
- M-MACH-102820 - Major Field: Mechatronics  
- M-MACH-102821 - Major Field: Technical Logistics

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<td>ST 2024</td>
<td>2150904</td>
<td>Automated Manufacturing Systems</td>
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<td>Lecture / Practice (On-Site)</td>
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**Exams**

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<th>SWS</th>
<th>Type / Practice</th>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**

oral exam (40 minutes)

**Prerequisites**

"T-MACH-102162 - Automatisierte Produktionsanlagen" must not be commenced.

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

**Automated Manufacturing Systems**

2150904, SS 2024, 6 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**

On-Site
Content
The lecture gives an overview of the structure and functioning of automated production plants. In a basic chapter, fundamental elements for the realisation of automated production systems are taught. These include:

- Drive and control technology
- Handling technology for handling workpieces and tools
- Industrial robot technology
- Quality assurance in automated production plants
- Automated machines, cells, centres and systems for production and assembly
- Structures of multi-machine systems
- Project planning of automated production plants

An interdisciplinary view of these sub-areas results in interfaces to Industry 4.0 approaches. The basic chapters are supplemented by practical application examples and live demonstrations in the Karlsruhe Forschungsfabrik.

In the second part of the lecture, the fundamentals taught will be clarified using practically executed production processes for manufacturing and disassembling components, and the automated production facilities for manufacturing these components will be analyzed. In the field of automotive powertrain technology, the automated production process for both the manufacture and disassembly of batteries is considered. In the powertrain area, automated production facilities for the disassembly of electric motors are considered. Furthermore, automated production systems for the field of additive manufacturing are considered.

Within tutorials, the contents from the lecture are deepened and applied to concrete 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
Vorlesungsstermine dienstags 8:00 Uhr und donnerstags 8:00 Uhr, Übungstermine donnerstags 09:45 Uhr.
Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung.

Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (https://www.karlsruher-forschungsfabrik.de) unterstützt.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (https://www.karlsruher-forschungsfabrik.de/en.html) to deepen the acquired knowledge.

Literature
Medien:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
8.10 Course: Automotive Engineering I [T-MACH-100092]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102815 - Major Field: Engineering Design  
M-MACH-102818 - Major Field: Vehicle Technology

<table>
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<th>Expansion</th>
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<td>Grade to a third</td>
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<td>Automotive Engineering I</td>
<td>4 SWS</td>
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<td>Gauterin, Gießler</td>
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**Legend:**  
🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🗔 Cancelled

**Competence Certificate**  
Written examination

**Duration:** 120 minutes

**Auxiliary means:** none

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

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

**Automotive Engineering I**  
2113805, WS 23/24, 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**
Das Vorlesungsmaterial wird auf ILIAS bereitgestellt. Das ILIAS-Passwort erhalten Sie unter https://fast-web-01.fast.kit.edu/Passwoerterlias/

Kann nicht mit der Veranstaltung [2113809] kombiniert werden.

Can not be combined with lecture [2113809].
Content
1. History and future of the automobile
2. Driving mechanics: driving resistances and driving performances, mechanics of longitudinal and lateral forces, active and passive safety
3. Drive systems: combustion engine, hybrid and electric drive systems
4. Transmission: clutches (e.g. friction clutch, visco clutch), transmission (e.g. mechanical transmission, hydraulic fluid transmission)
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Organizational issues
You will find the lecture material on ILIAS. To get the ILIAS password, KIT students refer to https://fast-web-01.fast.kit.edu/PasswoerterIlias/, students from eucor universities send an e-mail to martina.kaiser@kit.edu
Kann nicht mit LV Grundlagen der Fahrzeugtechnik I [2113805] kombiniert werden.
Can not be combined with lecture [2113805] Grundlagen der Fahrzeugtechnik I.

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

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102818 - Major Field: Vehicle Technology

**Type**
Written examination

**Credits**
4

**Grading scale**
Grade to a third

**Recurrence**
Each summer term

**Version**
1

<table>
<thead>
<tr>
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<th>Credits</th>
<th>Module</th>
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<th>Instructor(s)</th>
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<tbody>
<tr>
<td>ST 2024 2114835 Automotive Engineering II</td>
<td>2 SWS</td>
<td>Lecture</td>
<td>Gießler</td>
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**Exams**

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<td>Gauterin, Gießler</td>
</tr>
</tbody>
</table>

**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 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
On-Site

**Content**

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

**Learning Objectives:**

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

**Organizational issues**

Kann nicht mit der Veranstaltung [2114855] kombiniert werden.

Can not be combined with lecture [2114855]
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:

8.12 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-102638 - Major Field: Rail System Technology
M-MACH-102817 - Major Field: Information Technology
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102820 - Major Field: Mechatronics

Type
Written examination

Credits
6

Grading scale
Grade to a third

Recurrence
Each summer term

Version
2

Events

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Exams

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<td>Lecture</td>
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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:

Content

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

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

Nachweis: Written examination 60 minutes

Arbeitsaufwand (EN): 120 hours

Literature
Foliensatz zur Veranstaltung wird als kostenlose pdf-Datei bereitgestellt. Weitere Empfehlungen werden in der Vorlesung bekannt gegeben.
8.13 Course: Bachelor's Thesis [T-MACH-109188]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104494 - Bachelor's Thesis

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

**Competence Certificate**

The bachelor 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 workload of the bachelor thesis corresponds to 12 ECTS. The maximal processing time of the bachelor thesis takes three months. 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 bachelor 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 bachelor thesis is not completed in time, this examination is "failed" (5,0), unless the student is not responsible.

The bachelor thesis is to be evaluated by not less than a professor or a senior scientist according to § 14 Abs. 3 Ziff. 1 KITG and another examiner. Generally, one of the two examiners is the person who has assigned the thesis. If the examiners do not agree, the bachelor thesis is graded by the examination board within this assessment; another expert can be appointed too. The bachelor thesis has to be graded within a period of six weeks after the submission.

**Prerequisites**

The requirement for admission to the bachelor thesis module are 120 ECTS. As to exceptions, the examination board decides on a request of the student (see § 14 (1) SPO).

**Modeled Conditions**

The following conditions have to be fulfilled:

1. You need to have earned at least 120 credits in the following fields:
   - Fundamentals of Engineering
   - Interdisciplinary Qualifications
   - Specialization in Mechanical Engineering

**Final Thesis**

This course represents a final thesis. The following periods have been supplied:

- **Submission deadline**: 3 months
- **Maximum extension period**: 1 months
- **Correction period**: 6 weeks

**Annotation**

The workload for the preparation of the bachelor thesis is about 360 hours.
### 8.14 Course: Basics in Measurement and Control Systems [T-MACH-104745]

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

**Part of:** M-MACH-102564 - Measurement and Control Systems

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<td>3 SWS</td>
<td>Lecture / 🗣</td>
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<td>Practice / 🗣</td>
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**Exams**

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

**Competence Certificate**
- written exam
  - 2,5 hours

**Prerequisites**
- none

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

**Measurement and Control Systems**
- 2137301, WS 23/24, 3 SWS, Language: German, [Open in study portal](#)
Content
Lehrinhalt (EN):
1 Dynamic systems
2 Properties of important systems and modeling
3 Transfer characteristics and stability
4 Controller design
5 Fundamentals of measurement
6 Estimation
7 Sensors
8 Introduction to digital measurement

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

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

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

Arbeitsaufwand (EN):
210 hours

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

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

• Regelungstechnische Bücher:
  J. Lunze: Regelungstechnik 1 & 2, Springer-Verlag
  R. Unbehauen: Regelungstechnik 1 & 2, Vieweg-Verlag
  O. Föllinger: Regelungstechnik, Hüthig-Verlag
  W. Leonhard: Einführung in die Regelungstechnik, Teubner-Verlag

• Messtechnische Bücher:
  W. Pfeiffer: Elektrische Messtechnik, VDE Verlag Berlin 1999
  Kronmüller, H.: Prinzipien der Prozeßmeßtechnik 2, Schnäcker-Verlag, Karlsruhe, 1. Aufl., 1980
Content
Lehrinhalt (EN):

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

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

Nachweis (EN): written exam; duration 2.5 h; paper reference materials only (no calculator)
Arbeitsaufwand (EN): 180 hours

Literature

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

- Regelungstechnische Bücher:
  
  J. Lunze: Regelungstechnik 1 & 2, Springer-Verlag
  
  R. Unbehauen: Regelungstechnik 1 & 2, Vieweg-Verlag
  
  O. Föllinger: Regelungstechnik, Hüthig-Verlag
  
  W. Leonhard: Einführung in die Regelungstechnik, Teubner-Verlag
  

- Messtechnische Bücher:
  
  E. Schrüfer: Elektrische Meßtechnik, Hanser-Verlag, München, 5. Aufl., 1992
  
  
  
  W. Pfeiffer: Elektrische Messtechnik, VDE Verlag Berlin 1999
  
  Kronmüller, H.: Prinzipien der Prozeßmesstechnik 2, Schnäcker-Verlag, Karlsruhe, 1. Aufl., 1980
8.15 Course: Basics Module - Self Assignment BAK [T-ZAK-112653]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**
- Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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**Competence Certificate**
The monitoring in this module includes a course credit according to § 5 section 4 in the form of minutes of which two are to be handed in freely chosen topics of the lecture series “Introduction to Applied Studies on Culture and Society”. Length: approx. 6,000 characters each (incl. spaces).

**Self service assignment of supplementary studies**
This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Recommendation**

**Annotation**
The Basic Module consists of the lecture “Introduction to Supplementary Studies on Culture and Society”, which is offered only in the winter semester. It is therefore recommended that students start their studies in the winter semester and complete them before module 2.
8.16 Course: Basics Module - Self Assignment BeNe [T-ZAK-112345]

Responsible: Christine Myglas
Organisation: M-ZAK-106099 - Supplementary Studies on Sustainable Development

Type: Completed coursework
Credits: 3
Grading scale: pass/fail
Version: 1

Competence Certificate
The monitoring in this module includes a course credit according to § 5 section 4:
Introduction to Sustainable Development in the form of minutes of which two are to be handed in freely chosen topics of the lecture series "Introduction to Sustainable Development". Length: approx. 6,000 characters each (incl. spaces).
or
Sustainability Spring Days at KIT in the form of a reflection report on all components of the project days "Sustainability Spring Days at KIT". Length approx. 12,000 characters (incl. spaces).

Prerequisites
None

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

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation

Annotation
Module Basics consists of the lecture "Introduction to Sustainable Development", which is only offered in the summer semester or alternatively of the project days "Sustainability Spring Days at KIT", which is only offered in the winter semester. It is recommended to complete the course before Elective Module an Specialisation Module.

In exceptional cases, Elective Module or Specialisation Module can also be completed simultaneously with Basics Module. However, the prior completion of the advanced modules Elective and Specialisation should be avoided.
8.17 Course: Basics of Manufacturing Technology [T-MACH-105219]

**Responsible:** Prof. Dr.-Ing. Volker Schulze  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102549 - Manufacturing Processes

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**Events**

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<td>Fundamentals of Manufacturing Technology</td>
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<td>Schulze</td>
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</table>

**Prerequisites**

none

**Competence Certificate**

written exam (duration: 60 min)

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

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<th>Events</th>
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<th>Title</th>
<th>SWS</th>
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<tbody>
<tr>
<td>V</td>
<td>2149658</td>
<td>Basics of Manufacturing Technology</td>
<td>2</td>
<td>Lecture / Practice (VÜ)</td>
<td>Blended (On-Site/Online)</td>
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</table>
Content
The objective of the lecture is to classify the manufacturing technology within the wider context of production engineering, to provide an overview of the different manufacturing processes and to establish basic process knowledge of the common processes. The lecture conveys the basic principles of manufacturing technology and deals with the manufacturing processes based on example components according to their classification into main groups regarding technical and economic aspects. Regard is paid to classic manufacturing processes as well as new developments like additive manufacturing processes.

The following topics will be covered:

- Primary processing (casting, plastics engineering, sintering, additive manufacturing processes)
- Forming (sheet-metal forming, massive forming)
- Cutting (machining with geometrically defined and geometrically undefined cutting edges, separating, abrading)
- Joining
- Coating
- Heat treatment and surface treatment

Learning Outcomes:
The students ...

- are able to classify the manufacturing processes by their general functionality according to the specific main groups (DIN 8580).
- have the ability to declare and explain the function of the significant manufacturing processes of the main groups (DIN 8580).
- are enabled to describe the characteristic process features (geometry, materials, accuracy, tools, machines) of the significant manufacturing processes of the main groups (DIN 8580).
- have the ability to derive the relevant process specific technical advantages and disadvantages of the characteristic process features.
- are enabled to perform a selection of suitable manufacturing processes for given components.
- are enabled to classify the required manufacturing processes in the expiry of a process chain for the production of given sample products.

Workload:
regular attendance: 30 hours
self-study: 60 hours

Literature
Media:
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: Basics of Technical Logistics I [T-MACH-112841]

**Responsible:** Dr.-Ing. Martin Mittwollen  
Dr.-Ing. Jan Oellerich  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102821 - Major Field: Technical Logistics

**Events**

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

**Competence Certificate**

The assessment consists of an oral exam (duration approx. 20 minutes).

**Prerequisites**

none

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-109919 - Basics of Technical Logistics I must not have been started.

**Recommendation**

Knowledge of the basics of technical mechanics preconditioned.

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

**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. 2SPO).
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: 48Std
Nacharbeit: 132Std
presence: 48h
rework: 132h

Literature
Empfehlungen in der Vorlesung / Recommendations during lessons
**8.19 Course: Basics of Technical Logistics I [T-MACH-109919]**

**Responsible:** Dr.-Ing. Martin Mittwollen  
Dr.-Ing. Jan Oellerich  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-102746 - Compulsory Elective Module

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**Events**

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

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<td>Lecture / Practice (VÜ)</td>
<td>Mittwollen</td>
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**Competence Certificate**

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

**Prerequisites**

none

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-112841 - Basics of Technical Logistics I must not have been started.

**Recommendation**

Knowledge of the basics of technical mechanics preconditioned.

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

**Basics of Technical Logistics I**

2117095, WS 23/24, 4 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. 2SPO).
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: 48Std
Nacharbeit: 132Std
presence: 48h
rework: 132h

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

**Responsible:** Prof. Dr.-Ing. Kai Furmans  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102821 - Major Field: Technical Logistics

<table>
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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 and out of "Basic of Technical Logistics I" (T-MACH-109919) preconditioned.
8.21 Course: Behaviour Generation for Vehicles [T-MACH-105367]

**Responsible:** Maximilian Naumann
Moritz Werling

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102817 - Major Field: Information Technology
- M-MACH-102818 - Major Field: Vehicle Technology
- M-MACH-102820 - Major Field: Mechatronics
- M-MACH-102821 - Major Field: Technical Logistics

<table>
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**Events**

| WT 23/24   | 2138336 | Behaviour Generation for Vehicles | 3 SWS | Lecture / 🧩 | Werling, Naumann |

**Exams**

| ST 2024   | 76-T-MACH-105367 | Behaviour Generation for Vehicles | Stiller |
| ST 2024   | 76-T-MACH-105367 | Behaviour Generation for Vehicles | Stiller |

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

**Competence Certificate**

written examination

60 min.

Simple calculators are allowed, programmable or graphical ones are prohibited.

**Prerequisites**

none

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

**Behaviour Generation for Vehicles**

2138336, WS 23/24, 3 SWS, Language: German, Open in study portal

Lecture (V) Blended (On-Site/Online)
Kurzfassung (EN):
Driver assistance is on its way to evolve from pure driving dynamics control systems, such as ABS or ESP, to full automation. To realize new, customer-value safety and comfort systems, the primary task of active driving interventions in steering, accelerator and braking is shifting from the so-called vehicle stabilization level to the so-called vehicle guidance level, the new subject area of modern assistance systems. The challenge here is to provide optimum support for the driver without patronizing him. The next step is driving automation, in which the driving task is completely taken over, at least in certain situations. For highly and fully automated vehicles, the challenge is to produce pleasant, safe and predictable driving behavior under given uncertainties in the perception of the environment and the behavior of other road users.

Lernziele (EN):
The lecture is aimed at students of mechanical engineering and related courses who wish to acquire interdisciplinary qualifications in a future-oriented subject area. It covers control engineering, information technology and vehicle technology aspects and provides a holistic overview of the field of automated vehicle control. Practical application examples from innovative driver assistance and driving automation systems deepen and illustrate the lecture content.

Contents:
Part 1: Driver Assistance:
1) Introduction to driver assistance
2) System description and modeling
3) Assistance systems of the stabilization level
4) Assistance systems of the command level
Part 2: Driving Automation:
5) Introduction Maneuver Planning
6) Dynamic Programming
7) Linear-quadratic optimization problems
8) Model predictive control
9) Decision making under uncertainty (MDPs, reinforcement learning, imitation learning).

Prerequisites:
Basic knowledge of control engineering and systems theory should be available from "Measurement and Control Systems" or from lectures of other departments.

Nachweis: written exam
Arbeitsaufwand: 180 hours

Literature
Foliensatz zur Veranstaltung wird als kostenlose pdf-Datei bereitgestellt. Diese Folien sowie Beispielprogramme werden über ILIAS bereitgestellt bzw. verlinkt. Es wird empfohlen, falls vorhanden, ein eigenes Notebook mitzunehmen, da viele direkt ausführbare Programmbeispiele die Vorlesung begleiten.
8.22 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-102819 - Major Field: Materials Science and Engineering

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Events

| ST 2024 | 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, SS 2024, 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
8.23 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-102645 - Major Field: Combustion Engine Techniques

<table>
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Exams

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<td>Boosting of Combustion Engines</td>
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Competence Certificate
oral exam, 20 min

Prerequisites
none
8.24 Course: Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning [T-MACH-113359]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering  
Institute of Thermal Turbomachinery  
**Part of:** M-MACH-102838 - Major Field: Energy Converting Engines

<table>
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<th>Credits</th>
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**Completed coursework (oral)**  
**Credits:** 4  
**Grading scale:** Grade to a third  
**Recurrence:** Each winter term  
**Version:** 1

### Events

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**Exams**  
**Code:** 76-T-MACH-113359  
**Title:** Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning  
**Type:** Lecture / 🗣️  
**Instructor:** Ates, Bauer

**Competence Certificate**  
**Type:** Oral exam, approximately 30 minutes

**Prerequisites**  
Students successfully passed courses on fluid dynamics and thermodynamics.

**Recommendation**  
- Profound knowledge on thermodynamics and fluid mechanics is mandatory.  
- Machine and processes lecture (LVNr. 3134140) is highly recommended before taking this course.  
- The course requires basic knowledge in engineering mathematics and computer programming at an undergraduate level. Basic knowledge in python is strongly recommended.  
- We expect students to be interested in applying theoretical knowledge and translate it into real world experiments.

**Annotation**  
Lectures: 90 min; Lab sessions: 90 minutes (6 weeks)

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

<table>
<thead>
<tr>
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<th>Code</th>
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<th>Credits</th>
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<td>Lecture (V)</td>
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<td>On-Site</td>
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</tbody>
</table>
Content
This lecture provides a comprehensive exploration of how small radial flow turbo machines contribute to the modern energy landscape. A typical application of such machines are pressurized fuel cells used as drive train for cars and trucks. From understanding the thermodynamics and flow characteristics of centrifugal compressors and centripetal turbines to practical experiments and the integration of machine learning techniques, students will gain a holistic understanding of the potential of turbo machines for energy conversion efficiency, emissions reduction, and performance optimization. The lecture further provides a hands-on sample application of machine learning, with a specific focus on its pivotal role in developing digital twins that utilize sensory data.

During an integrated lab course, learned theoretical A.I. frameworks are applied to a turbo machine test rig for the accurate prediction of the operation and proactive prevention of surge and stall. By engaging in these experimental lab, students explore how sensory data can be leveraged to monitor and optimize the performance of centrifugal compressors. By combining theory and practical lab experience, this course equips students with the knowledge and skills necessary to leverage turbomachinery technology in shaping a sustainable and efficient future energy ecosystem.

The lecture features a distinctive structure consisting of three interconnected layers:

1. Fundamental Learning: This initial phase takes place in a traditional classroom setting where students establish a solid understanding of the subject matter.
2. Hands-On Practical Application: Students then transition to two dedicated laboratory sessions where they apply the acquired knowledge using real-life equipment, gaining valuable hands-on experience.
3. Data Analysis and Interpretation: Following the practical sessions, the lecture moves into two virtual laboratory sessions focused on data-driven techniques. Here, students analyze and interpret the data collected during the hands-on sessions, applying their newfound skills.

This unique approach endows the lecture with a marathon-like nature, requiring students to progress through these phases in sync with their peers. Collaboration is key, as lab sessions are conducted in groups, and students will consolidate and utilize data from all groups. Effective in-group and between-group communication becomes essential for the overall success of the learning experience.

The lecture duration is 21 hours, divided into theory and practical sessions.

Upon completing this lecture, students will:

• Gain a comprehensive understanding of radial flow turbo machinery technology and its significance in the modern energy landscape.
• Learn the characteristics of centrifugal compressors and centripetal turbines and how they contribute to energy conversion efficiency, emissions reduction, and performance optimization.
• Engage in practical experiments to explore compressor characteristics, radial flow compressors and turbines, and surge and stall phenomena in radial compressors.
• Be introduced to machine learning principles and applications in turbomachinery technology.
• Gain hands-on experience in building digital twins from sensory data to monitor and optimize centrifugal compressor performance.
• Understand the importance of data-driven predictive maintenance and outlier detection in radial flow turbo machines.
• Learn how to use machine learning techniques to predict and prevent surge and stall issues in centrifugal compressor applications.
• Develop the knowledge and skills necessary to leverage turbomachinery technology in shaping a sustainable and efficient future energy ecosystem.

Organizational issues
Vorlesung ersetzt Vorlesung-Nr. 2169462 (Turbinen und Verdichterkonstruktionen) ab WS 2023/24

Number of participants are limited due to physical constraints of the integrated lab sessions. To enroll in the lecture, kindly complete the form below. Registration is open from 16.10.2023 (00:00:00) to 23.10.2023 (23:59:00) (Note: The registration period will be extended until 25.10.2023 (23:59:00).) Following the closure of the registration period, applicants will receive notifications regarding their selection, considering the limited number of available spots.

• Only master level students can be admitted to the course.
• Profound knowledge on thermodynamics and fluid mechanics is mandatory.
• Basic knowledge in python is strongly recommended.
• Machine and processes lecture is highly recommended before taking this course.
• We expect students to be interested in applying theoretical knowledge and translate it into real world experiments.
• Lecture is offered in English.

The lecture is part of the "Research Infrastructures in Research-Oriented Teaching (RIRO)" initiative at KIT.

Literature
- gitlab.kit.edu/cihan.ates/data-driven-engineering
### 8.25 Course: BUS-Controls - Advance [T-MACH-108889]

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

**Part of:** M-MACH-102820 - Major Field: Mechatronics

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<th>Each summer term</th>
<th>Version</th>
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</table>

**Competence Certificate**  
Creation of control program

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

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

**Part of:** M-MACH-102583 - Major Field: Information Management

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<td>CAD-NX training course</td>
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**Exams**

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<td>CAD-NX Training Course</td>
<td>Ovtcharova</td>
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**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, WS 23/24, 2 SWS, Language: German, [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 kann entweder vorlesungsbegleitend oder als einwöchige Blockveranstaltung in der vorlesungsfreien Zeit absolviert werden. Weitere Informationen siehe ILIAS.

**Literature**

Praktikumsskript
CAD-NX training course  
2123357, SS 2024, 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

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- 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
Informationen zum Ablauf des Praktikums werden in einer Auftaktveranstaltung veröffentlicht. Hinweise hierzu siehe ILIAS.

Literature
Praktikumsskript
8.27 Course: CAE-Workshop [T-MACH-105212]

Responsibility: Prof. Dr.-Ing. Albert Albers
               Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102583 - Major Field: Information Management
- M-MACH-102746 - Compulsory Elective Module
- M-MACH-102815 - Major Field: Engineering Design
- M-MACH-102820 - Major Field: Mechatronics

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

Competence Certificate

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

Prerequisites

None

Annotation

Consistent attendance on the workshop days is required for successful participation in the exam. The number of participants is limited. Selection will be made by drawing lots after the end of the registration period.

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

Content

Content:

- Introduction to the finite element analysis (FEA)
- Stress and modal analysis of finite element models using Abaqus/CAE as a preprocessor and Abaqus solver
- Introduction to topology and shape optimization
- Creation and calculation of various optimization models with the Abaqus optimization package

The students are able to:

- name the purposes and limits of numerical simulation and optimization of the virtual product development.
- solve simple realistic tasks in the field of finite element analysis and structure optimization with industrial common software.
- evaluate and to question the results of a simulation.
- identify and improve the mistakes of a simulation or optimization.

Regular attendance: 31.5 h
Self-study: 88.5 h
Exam: 1h written

Organizational issues

Wir empfehlen den Workshop ab dem 5. Semester.
Anmeldung erforderlich. Weitere Informationen siehe IPEK-Homepage.
Anwesenheitspflicht

Bachelor's Program Mechanical Engineering (B.Sc.), Date: 23/02/2024
Module Handbook, valid from Summer Term 2024
CAE-Workshop
2147175, SS 2024, 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

Annotation: Number of participants limited. The selection will be made by drawing after the end of the registration period.

Organizational issues
Wir empfehlen den Workshop ab dem 5. Semester.

Anmeldung erforderlich. Weitere Informationen siehe IPEK-Homepage.

Anwesenheitspflicht

Literature
Kursunterlagen werden in Ilias bereitgestellt.
Content is provided on Ilias.
8.28 Course: CATIA CAD Training Course [T-MACH-102185]

- **Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova
- **Organisation:** KIT Department of Mechanical Engineering
- **Part of:** M-MACH-102583 - Major Field: Information Management

### Type
- Completed coursework (practical)
- Credits: 2
- Grading scale: pass/fail
- Recurrence: Each term
- Version: 2

### Events

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<td>CATIA CAD training course</td>
<td>2 SWS</td>
<td>Practical course / Ovtcharova, Mitarbeiter</td>
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### Exams

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<td>CATIA CAD Training Course</td>
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<td>Each term</td>
<td>Ovtcharova</td>
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</table>

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

**Prerequisites**
- None

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

**Annotation**
- For the practical course attendance is compulsory.

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

#### CATIA CAD training course

- Code: 2123358, WS 23/24, 2 SWS, Language: German, Open in study portal
- Practical course (P) Blended (On-Site/Online)

**Content**

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

Students are able to:

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

**Organizational issues**
- Das Praktikum kann vorlesungsbegleitend absolviert werden oder als einwöchige Blockveranstaltung in der vorlesungsfreien Zeit. Weitere Informationen siehe ILIAS.

**Literature**
- Praktikumskript
Content

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

Students are able to:

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

Organizational issues

Informationen zum Ablauf des Praktikums werden in einer Auftaktveranstaltung veröffentlicht. Hinweise hierzu siehe ILIAS.

Literature

Praktikumskript
8 COURSES

Course: CO2-Neutral Combustion Engines and their Fuels I [T-MACH-111550]

8.29 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-102818 - Major Field: Vehicle Technology
 M-MACH-102838 - Major Field: Energy Converting Engines

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

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Exams

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</table>

Kubach, Koch

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 23/24, 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
8.30 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-102818 - Major Field: Vehicle Technology
- M-MACH-102838 - Major Field: Energy Converting Engines

<table>
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<tr>
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**Exams**

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<td>Combustion Engines, Hydrogen Engines and CO2 neutral Fuels II</td>
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**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:

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

2134151, SS 2024, 3 SWS, Language: German, [Open in study portal](#)
8.31 Course: Cognitive Automobiles - Laboratory [T-MACH-105378]

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

**Organisation:**
KIT Department of Mechanical Engineering

**Part of:**
M-MACH-102821 - Major Field: Technical Logistics

<table>
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**Events**

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<td>3 SWS</td>
<td>Cognitive Automobiles - Laboratory</td>
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**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:*

**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.
8.32 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-102812 - Major Field: Powertrain Systems
M-MACH-102818 - Major Field: Vehicle Technology

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### Events

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**Events**

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<th>4 SWS</th>
<th>Lecture / Practice ( / )</th>
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**Exams**

| WT 23/24 | 76-T-MACH-102194 | CO2-neutral combustion engines and their fuels I |  | Kubach, Koch |

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

---

**Competence Certificate**

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

**Prerequisites**

none

---

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

**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
8 COURSES

8.33 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

**Type**
- Written examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each summer term

**Version**
- 2

**Events**

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<th>2 SWS</th>
<th>Lecture / 🧩 Henning</th>
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**Exams**

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<td>Henning</td>
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**Competence Certificate**
- written exam 90 minutes

**Prerequisites**
- none

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

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

2114053, SS 2024, 2 SWS, Language: German, Open in study portal

Lecture (V) Blended (On-Site/Online)
Content
Physical connections of fiber reinforcement

Use and examples
- Automotive construction
- Transport
- Energy and construction
- Sport and recreation

Resins
- Thermoplastics
- Duromeres

Mechanisms of reinforcements
- Glas fibers
- Carbon fibers
- Aramid fibers
- Natural fibers

Semi-finished products - textiles

Process technologies - 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.

Organizational issues
Die Lehrveranstaltung wird im SS 2024 als Hybridveranstaltung geplant.

Literature
Literatur Leichtbau II
[1-7]

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

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics
- M-MACH-104442 - 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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**Exams**

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<td>Lecture / On-Site</td>
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<td>Lecture / On-Site</td>
<td>Proppe</td>
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**Legend:**
- Online
- Blended (On-Site/Online)
- On-Site
- Cancelled

**Competence Certificate**
- oral exam, duration approx. 20 min.

**Prerequisites**
- none

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

**Computational Dynamics**

- 2162246, WS 23/24, 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!

**Computational Dynamics**

- 2162246, SS 2024, 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!
8.35 Course: Computational Intelligence [T-MACH-105314]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102817 - Major Field: Information Technology
- M-MACH-102820 - Major Field: Mechatronics

<table>
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**Events**

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<th>2 SWS</th>
<th>Lecture / Online</th>
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**Exams**

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<td>76-T-MACH-105314</td>
<td>Computational Intelligence</td>
<td>Mikut</td>
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</table>

**Competence Certificate**

Written exam (Duration: 1h)

**Prerequisites**

none

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

**Computational Intelligence**

2105016, WS 23/24, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

Blended (On-Site/Online)

**Content**

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

**Content:**

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

**Learning objectives:**

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


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)
8.36 Course: Computational Vehicle Dynamics [T-MACH-105350]

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

- **Part of:**
  - M-MACH-102638 - Major Field: Rail System Technology
  - M-MACH-102818 - Major Field: Vehicle Technology
  - M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics

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

<table>
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| WT 23/24 2162256 | Computational Vehicle Dynamics  
| ST 2024 2162256 | Computational Vehicle Dynamics  
| Exams |  
| WT 23/24 76-T-MACH-105350 | Computational Vehicle Dynamics  
| ST 2024 76-T-MACH-105350 | Computational Vehicle Dynamics |

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

**Prerequisites**  
none

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

**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 23/24, 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
8 COURSES

Course: Computer Science for Engineers [T-MACH-105205]

8.37 Course: Computer Science for Engineers [T-MACH-105205]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102563 - Computer Science

<table>
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Events

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<tr>
<td>ST 2024</td>
<td>4 SWS</td>
<td>Elstermann, Meyer</td>
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Exams

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<tr>
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<td>Ovtcharova, Elstermann</td>
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<tr>
<td>ST 2024</td>
<td>4 SWS</td>
<td>Meyer, Elstermann</td>
</tr>
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</table>

Competence Certificate
Written exam [180 min]

Prerequisites
Computer Science for Engineers, passed

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105206 - Computer Science for Engineers, Prerequisite must have been passed.

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

Computer Science for Engineers

<table>
<thead>
<tr>
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<th>Credits</th>
<th>Lecturer(s)</th>
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<tbody>
<tr>
<td>2121390</td>
<td>4 SWS</td>
<td>Elstermann, Meyer</td>
</tr>
</tbody>
</table>

Content
Basics: Information representation- and processing, terms and definitions: alphabet, data, signals, information, numeral systems, propositional logic and Boolean algebra, computer architectures, programming paradigms.
Object Orientation: Definition and important characteristics of object orientation, Object-oriented modeling with UML.
Data Structures: Definition, properties and application of graphs, trees, linked lists, queues and stacks.
Algorithms: Characteristics of algorithms, complexity analysis, design methods, important examples.
Database management systems: Relational data model, relational algebra, declarative language SQL.

Organizational issues
Literature
„Grundkurs Programmieren in Java“ Carl Hanser Verlag GmbH & CO. KG; Auflage 6, ISBN 10: 3446426639

Computer Science for Engineers
3121034, SS 2024, 4 SWS, Language: English, Open in study portal

Content
Basics: Information representation- and processing, terms and definitions: alphabet, data, signals, information, numeral systems, propositional logic and Boolean algebra, computer architectures, programming paradigms.
Object Orientation: Definition and important characteristics of object orientation, Object-oriented modeling with UML.
Data Structures: Definition, properties and application of graphs, trees, linked lists, queues and stacks.
Algorithms: Characteristics of algorithms, complexity analysis, design methods, important examples.
Database management systems: Relational data model, relational algebra, declarative language SQL.

Literature
8.38 Course: Computer Science for Engineers, Prerequisite [T-MACH-105206]

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

**Part of:** M-MACH-102563 - Computer Science

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<td>Computer Lab for Computer Science in Mechanical Engineering</td>
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<td>3121036</td>
<td>Computer Science for Engineers Lab Course</td>
<td>2 SWS</td>
<td>/ 📝</td>
<td>Elstermann, Meyer</td>
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**Exams**

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<td>Computer Science for Engineers, Prerequisite</td>
<td>Each summer term</td>
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</table>

**Competence Certificate**

Programming assignments, that are to be implemented at the computer, are given every two weeks. The students are supervised by tutors while they work on the assignments. Therefore online tests must be solved by the students to assess the understanding of the tasks and the lecture material. All assignments have to be handed in, before they can take part in the exam.

**Prerequisites**

none

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

### Computer Lab for Computer Science in Mechanical Engineering

2121392, SS 2024, 2 SWS, Language: German, [Open in study portal](#)  
**On-Site**

**Content**

JAVA programming assignments, that are to be implemented at the computer, are given every two weeks. The students are supervised by tutors while they work on the assignments. Therefore online tests must be solved by the students to assess the understanding of the tasks and the lecture material. All assignments have to be handed in, before they can take part in the exam.

**Organizational issues**

Wenn Poolräume nutzbar, dann Poolräume

**Literature**

Übungsblätter / exercise sheets

### Computer Science for Engineers Lab Course

3121036, SS 2024, 2 SWS, Language: English, [Open in study portal](#)  
**Online**

**Content**

JAVA programming assignments, that are to be implemented at the computer, are given every two weeks. The students are supervised by tutors while they work on the assignments. Therefore online tests must be solved by the students to assess the understanding of the tasks and the lecture material. All assignments have to be handed in, before they can take part in the exam.

**Organizational issues**

Wenn Präsenz möglich, dann ID-Raum Nutzung

**Literature**

Exercise sheets / Übungsblätter

Bachelor's Program Mechanical Engineering (B.Sc.), Date: 23/02/2024  
Module Handbook, valid from Summer Term 2024
Course: Constitution and Properties of Wearresistant Materials [T-MACH-102141]

**Responsible:** Prof. Sven Ulrich  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

<table>
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<td>Each summer term</td>
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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:

**Lecture (V)**  
**Constitution and Properties of Wear resistant materials**  
2194643, SS 2024, 2 SWS, Language: German, Open in study portal  

**Content**
The assessment consists of an oral exam (ca. 30 min) taking place at the agreed date (according to Section 4(2), 2 of the examination regulation). The re-examination is offered upon agreement.

Teaching Content:
- introduction
- materials and wear
- unalloyed and alloyed tool steels
- high speed steels
- stellites and hard alloys
- hard materials
- hard metals
- ceramic tool materials
- superhard materials
- new developments
- regular attendance: 22 hours
- self-study: 98 hours

Basic understanding of constitution of wear-resistant materials, of the relations between constitution, properties and performance, of principles of increasing of hardness and toughness of materials as well as of the characteristics of the various groups of wear-resistant materials.

Recommendations: none
Organizational issues
Die Blockveranstaltung findet in folgendem Zeitraum statt:
15.04.-17.04.2024: jeweils von 8:00-16:00 Uhr;
Ort: KIT-CN, Geb. 681, Raum 214
Anmeldung verbindlich bis zum 13.04.2024 unter sven.ulrich@kit.edu.
Nach der Anmeldung wird Ihnen im Falle einer Online-Veranstaltung der Link zur Vorlesung per E-Mail am 14.04.2024 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
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-102582 - Major Field: Continuum Mechanics  
M-MACH-102746 - Compulsory Elective Module

---

### Type

- **Written examination**
- **Credits:** 3
- **Grading scale:** Grade to a third
- **Recurrence:** Each winter term
- **Expansion:** 1 terms
- **Version:** 5

### Events

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<th>Grading scale</th>
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<td>Böhlke, Frohnapfel</td>
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<tr>
<td></td>
<td>Continuum mechanics of solids and fluids</td>
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</tbody>
</table>

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

### Competence Certificate

Written examination (90 min). Additives as announced

### Prerequisites

Coursework in *Tutorial Continuum Mechanics of Solids and Fluids* (T-MACH-110333) must be passed

### 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:

#### V Continuum mechanics of solids and fluids

2161252, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

### 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
8.41 Course: Control of Mobile Machines [T-MACH-111821]

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

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:**  
- M-MACH-102812 - Major Field: Powertrain Systems  
- M-MACH-102817 - Major Field: Information Technology  
- M-MACH-102820 - Major Field: Mechatronics

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

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

**Prerequisites**  
A prerequisite for participation in the examination is the preparation of a semester report. The preexamination with the code T-MACH-111820 must be passed.

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

1. The course T-MACH-111820 - Control of Mobile Machines – Prerequisites must have been passed.
8.42 Course: Control of Mobile Machines – Prerequisites [T-MACH-111820]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102812 - Major Field: Powertrain Systems
- M-MACH-102817 - Major Field: Information Technology
- M-MACH-102820 - Major Field: Mechatronics

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<td>Each summer term</td>
<td>1</td>
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</tbody>
</table>

**Competence Certificate**
Preparation of a report on the completion of the semester task

**Prerequisites**
none
8.43 Course: Control Technology [T-MACH-105185]

** Responsible: ** Hon.-Prof. Dr. Christoph Gönnheimer  
** Organisation: ** KIT Department of Mechanical Engineering

** Part of: **  
M-MACH-102812 - Major Field: Powertrain Systems  
M-MACH-102817 - Major Field: Information 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 **

Written Exam (60 min)

** Prerequisites **

none

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

** Control Technology **

2150683, SS 2024, 2 SWS, Language: German, [Open in study portal](#)
Content
The lecture control technology gives an integral overview of available control components within the field of industrial production systems. The first part of the lecture deals with the fundamentals of signal processing and with control peripherals in the form of sensors and actors which are used in production systems for the detection and manipulation of process states. The second part handles with the function of electric control systems in the production environment. The main focus in this chapter is laid on programmable logic controls, computerized numerical controls and robot controls. Finally the course ends with the topic of cross-linking and decentralization with the help of bus systems. The lecture is very practice-oriented and illustrated with numerous examples from different branches.

The following topics will be covered:

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

Learning Outcomes:
The students …

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

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

Organizational issues

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (https://www.karlsruher-forschungsfabrik.de/en.html) to deepen the acquired knowledge.

Literature
Medien:
Skript zur Veranstaltung wird über ilias bereitgestellt.

Media:
Lecture notes will be provided in ilias.
8.44 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-102817 - Major Field: Information Technology
M-MACH-102820 - Major Field: Mechatronics

<table>
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**Events**

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<td>WT 23/24</td>
<td>Data Analytics for Engineers</td>
<td>Mikut</td>
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<tr>
<td>ST 2024</td>
<td>Datenanalyse für Ingenieure</td>
<td>Mikut, Reischl</td>
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</table>

**Competence Certificate**

Written exam (Duration: 1h)

**Prerequisites**

none

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

**Data Analytics for Engineers**

2106014, SS 2024, 3 SWS, Language: German, [Open in study portal](#)

**Lecture / Practice (VÜ)**

Blended (On-Site/Online)

**Content**

- Introduction and motivation
- Terms and definitions (types of multidimensional features - time series and images, problem classes)
- Scenario: Problem formulation, feature extraction, evaluation, selection and transformation, distance measures, Bayes classifiers, Support-Vector-Machines, decision trees, clustering, regression, validation
- Biweekly computer exercises (Software practice with SciXMiner and Python): Data import, benchmark datasets, control of hand prostheses, energy prediction
- 2 hours per week lectures, 1 hour per week computer training

**Learning objectives:**

The students are able to apply the methods of data analysis efficiently. They know the basic mathematical data mining foundations for the analysis of single features and time series using classifiers, clustering and regression approaches. They are able to use various relevant methods as Bayes classifiers, Support Vector Machines, decision trees, fuzzy rulebases and they can adapt application scenarios (with data preprocessing and validation techniques) to real-world applications.
**Literature**

Vorlesungsunterlagen (ILIAS)

Mikut, R.: Data Mining in der Medizin und Medizintechnik. Universitätsverlag Karlsruhe. 2008 (PDF frei im Internet)


8.45 Course: Data-Driven Algorithms in Vehicle Technology [T-MACH-112126]

**Responsible:** Dr. Stefan Scheubner  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102818 - Major Field: Vehicle Technology

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

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<td>Lecture / 🧩</td>
<td>Scheubner</td>
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</table>

**Competence Certificate**

Written Examination  
Duration: 90 minutes

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

**Data-Driven Algorithms in Vehicle Technology**

2113840, WS 23/24, 2 SWS, Language: English, Open in study portal  
Lecture (V)  
Blended (On-Site/Online)  

**Content**

Course Syllabus: Data-Driven Algorithms in Vehicle Technology  
Motivation for the Course: Nowadays, engineers often develop technical systems using a combination of hard- and software. This is true especially for modern passenger vehicle development. In a digitalized world, such developments are built on knowledge gained from relevant data sources, e.g. the vehicle sensors. Therefore, engineers in automobile technology need qualifications from data science to successfully create new functionalities in the cars. To prevent remaining purely theoretical, the algorithms in this course are explained using a real-world problem of “EV Routing”. Students have the opportunity to test methods in Python with frequent exercises presented.  
Goal of the Course: Students have a basic understanding of data-driven algorithms such as Markov Models, Machine Learning or Monte-Carlo Methods. The approach for building data-driven models in automobile technology are known to students and they are able to test algorithms in the programming language “Python”. Furthermore, students have learnt how to analyse the algorithm performance.  
Content:  
1. Introduction to function development as well as the prerequisites for the course (e.g. Fundamentals for running Python code)  
2. Fundamentals for EV Routing and relevant data sources  
3. Parameter estimation and state classification algorithms to determine the current situation of the vehicle  
4. Learning methods for driver behaviour  
5. Forecast algorithms to predict future energy consumption of an electric vehicle  

**Organizational issues**

Das Vorlesungsmaterial wird auf ILIAS bereitgestellt. Das ILIAS-Passwort erhalten Sie unter https://fast-web-01.fast.kit.edu/Passwoerterilias/  
Die erste VL am 24.10. um 14:00 Uhr findet in Präsenz am Campus Ost, Geb. 70.04, Raum 219 statt.
### 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-102815 - Major Field: Engineering Design

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

#### Events

<table>
<thead>
<tr>
<th>Events</th>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
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<td>2 SWS</td>
<td>Lecture /</td>
<td>Geimer</td>
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**Exams**

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<td>Design and Development of Mobile Machines</td>
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<td>Geimer</td>
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</tr>
</tbody>
</table>

**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.

### Content:

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

### Literature:

See german recommendations

---

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

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-102815 - Major Field: Engineering Design

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Exams

| WT 23/24 | 76-T-MACH-108887 | Design and Development of Mobile Machines - Advance | Geimer |

Competence Certificate
Preparation of semester report

Prerequisites
none
8.48 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-102812 - Major Field: Powertrain Systems
- M-MACH-102818 - Major Field: Vehicle Technology

<table>
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**Events**

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<td>Design and Optimization of Conventional and Electrified Automotive Transmissions</td>
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<td>Each summer term</td>
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</tbody>
</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:

**Design and Optimization of Conventional and Electrified Automotive Transmissions**

**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-Gearboxen;
- 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.

Bachelor's Program Mechanical Engineering (B.Sc.), Date: 23/02/2024
Module Handbook, valid from Summer Term 2024
8.49 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-102838 - Major Field: Energy Converting Engines

<table>
<thead>
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**Events**

| WT 23/24 | 2232310 | Design of a Jet Engine Combustion Chamber | 2 SWS | Harth |

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
## 8.50 Course: Design with Plastics [T-MACH-105330]

** Responsible:** Dipl.-Ing. Markus Liedel  
** Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102815 - Major Field: Engineering Design  
- M-MACH-102819 - Major Field: Materials Science and Engineering

<table>
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### Events

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<td>Design with Plastics</td>
<td>2 SWS</td>
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#### Competence Certificate

Oral exam, about 20 minutes

**Prerequisites**

none

**Recommendation**

Poly 1

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

<table>
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<th>Block (B)</th>
<th>On-Site</th>
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<td>Block (B)</td>
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Content
Structure and properties of plastics materials,
Processing of plastics,
Behavior of plastics under environmental impacts,
Classic strength dimensioning,
Geometric dimensioning,
Plastic appropriate design,
Failure examples,
Joining of plastic parts,
Supporting simulation tools,
Structural foams,
Plastics Technology trends.

Learning objectives:
Students will be able to

- distinguish polymer compounds from other construction materials regarding chemical differences, thermal behavior and solid conditions.
- discuss main plastics processes regarding advantages and disadvantages of materials selection and part geometry design and to make appropriate selections.
- analyze complex application requirements concerning material impacts on strength and to use the classic dimensioning method specific to the application to evaluate the lifetime part strength limit.
- evaluate part tolerances and geometry by appropriate methods considering molding shrinkage, production tolerances, post shrinkage, heat expansion, swelling, elastic and creep deformation.
- design plastic specific joining geometries like snap fits, screw bosses, weld seams and film hinges.
- detect classic molding failures and understand potential causes as well as to reduce the probability of molding failures by defining an optimized design.
- understand benefits and limits of selected simulation tools in the plastic technology discipline (strength, deformation, filling, warpage).
- assess polymer classes and plastic part designs with respect to suitable recycling concepts and ecological consequences.

Requirements:
none,

Recommendation: Polymerengineering I

Workload:
The workload for the lecture Design with Plastics is 120 h per semester and consists of the presence during the lecture (21 h) as well as preparation and rework time at home (99 h).

Organizational issues
Anmeldung unter Markus.Liedel@de.bosch.com

Literature
Materialien werden in der Vorlesung ausgegeben.
Literaturhinweise werden in der Vorlesung gegeben.
### 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-102815 - Major Field: Engineering Design

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<td>Grade to a third</td>
<td>Each winter term</td>
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<td>WT 23/24</td>
<td>Designing with numerical methods in product development</td>
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</table>

**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 23/24, 2 SWS, Language: German, Open in study portal

**Content**


**Organizational issues**

Beginn ab 09.11.2023

**Literature**

Vorlesungsskript
8.52 Course: Development Methods of Technical Systems [T-MACH-111283]

**Responsible:** Dipl.-Ing. Thomas Maier  
Prof. Dr.-Ing. Jivka Ovtcharova  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102583 - Major Field: Information Management

### Events

<table>
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<th>Recurrence</th>
<th>Expansion</th>
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<td>Each term</td>
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#### Exams

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

### Competence Certificate

Graded examination of other type weighted 50% project documentation and 50% colloquium.

### Prerequisites

None

### Recommendation

None

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

#### Development methods of technical systems

**2121002, WS 23/24, 4 SWS, Language: German/English, Open in study portal**

**Project (PRO) On-Site**

**Content**

Requirements, SysML, Modelica, FEM high performance computing, process modeling, VR/AR

Students can exemplarily:

- Collect requirements for large technical systems (e.b.: Helmholtz large-scale device KATRIN).
- Describe physical systems across domains with the modeling language Modelica and simulate the systems behavior.
- Generate simple FE meshes for simulations of structural mechanics.
- Perform general FEM analyses on mainframe computers and prepare and explain simulation results.
- As a team present the learned skills and document them continuously.

#### Development methods of technical systems

**2121002, SS 2024, 4 SWS, Language: German/English, Open in study portal**

**Project (PRO) On-Site**

**Content**

Requirements, SysML, Modelica, FEM high performance computing, process modeling, VR/AR

Students can exemplarily:

- Collect requirements for large technical systems (e.b.: Helmholtz large-scale device KATRIN).
- Describe physical systems across domains with the modeling language Modelica and simulate the systems behavior.
- Generate simple FE meshes for simulations of structural mechanics.
- Perform general FEM analyses on mainframe computers and prepare and explain simulation results.
- As a team present the learned skills and document them continuously.
8.53 Course: Development of Hybrid Drivetrains [T-MACH-110817]

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

**Part of:**  
- M-MACH-102645 - Major Field: Combustion Engine Techniques  
- M-MACH-102818 - Major Field: Vehicle Technology  
- M-MACH-102838 - Major Field: Energy Converting Engines

<table>
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**Events**

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<th>2 SWS</th>
<th>Lecture / 🗣</th>
<th>Koch, Doppelbauer</th>
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</table>

**Exams**

| WT 23/24 | 76-T-MACH-110817 | Development of hybrid drivetrains |  | | Koch |

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

**Competence Certificate**  
written exam, 1 hour

**Prerequisites**  
None

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

**Development of Hybrid Powertrains**  
2134155, SS 2024, 2 SWS, Language: German, Open in study portal

**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
8.54 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-102812 - Major Field: Powertrain Systems  
M-MACH-102815 - Major Field: Engineering Design  
M-MACH-102818 - Major Field: Vehicle Technology  
M-MACH-102838 - Major Field: Energy Converting Engines

<table>
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</tr>
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</table>

**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 23/24, 2 SWS, Language: German, Open in study portal  
Block (B)  
Blended (On-Site/Online)

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

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

knowledge in the fluidics  
- regular attendance: 19 hours  
- self-study: 90 hours

**Organizational issues**  
siehe Homepage
Course: Digital Control [T-MACH-105317]

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

**Part of:**  
M-MACH-102817 - Major Field: Information Technology  
M-MACH-102820 - Major Field: Mechatronics

<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**

written exam  
60 min.

**Prerequisites**

none

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

**Digital Control**

2137309, WS 23/24, 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.

Nachweis: oral examination; duration: 30 minutes

Arbeitsaufwand: 120 hours

**Literature**

- Föllinger, O.: Lineare Abtastsysteme. 4. Auflage, R. Oldenbourg Verlag, München Wien 1990
8.56 Course: Digitization in the Railway System [T-MACH-113016]

Responsible: Prof. Dr.-Ing. Martin Cichon
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102638 - Major Field: Rail System Technology

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

**Competence Certificate**

Oral examination
Duration: approx. 20 minutes
No tools or reference material may be used during the exam.
8.57 Course: Dimensioning of Additive-Manufactured Polymer Structures at an Example from Medical Engineering [T-MACH-112717]

 Responsible: Prof. Dr.-Ing. Luise Kärger
 Organisation: KIT Department of Mechanical Engineering
 Part of:
 M-MACH-102746 - Compulsory Elective Module
 M-MACH-102815 - Major Field: Engineering Design
 M-MACH-102820 - Major Field: Mechatronics

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<td>3 SWS</td>
<td>Lecture / Practice ( / 🧩)</td>
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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:

### Dimensioning of additive-manufactured polymer structures at an example from medical engineering

2114102, SS 2024, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ) Blended (On-Site/Online)
Content
Additive manufacturing (AM) processes, also known as "3D printing", allow the economical production of individualised components with a high degree of design freedom. This makes them particularly important in industries with very low quantities and many prototype tests, such as medical engineering. In orthopaedics, for example, it is often helpful to adapt splints or orthoses to the patient's individual anatomy and functional requirements. Due to their good processability, adjustable properties and low density, polymer-based materials are increasingly applied. However, the goal-oriented development of such customised polymer components requires knowledge of the according processes and materials and can be effectively supported by computer-aided CAE methods.

In the course, students learn about additive manufacturing (AM) of individualised polymer components and apply their competences in a development project during the semester. The course first provides an overview of established AM process technologies and uses the example of extrusion processes to work out the interaction of material, process settings and design. Special requirements of medical technology for component development and material selection are presented in separate lectures. This is followed by an application-oriented introduction to the practical component design of printed polymer structures using the finite element method (FEM). FE-based topology optimisation is presented as a particularly suitable tool to devise efficient mechanical structures. The CAE design methods are specifically deepened in practice during exercises. With this knowledge of processes, materials and methods, the students finally solve an individual development project from the field of orthotics in small groups.

Main topics:
- Overview of additive manufacturing processes
- Process-material-component interaction
- Polymers in additive manufacturing:

Fundamentals of polymer science, material and component testing,

- Special aspects of additive manufacturing in medical technology (external guest contributions):

Selection of process and material, orthotics/prosthetics as an application case

- Computer-aided component design and optimisation
- (lectures and exercises)
- Semester project:
  Design, manufacture and testing of an AM component from the field of "medical technology"

Learning objectives
The students can...

- name and describe different AM manufacturing technologies for polymer components and select them based on their characteristics (especially advantages/disadvantages and process limits).
- describe the development chain in additive manufacturing (material selection, CAD, simulation/optimisation, slicer software) and implement it.

- describe the interaction of process parameters, material properties and design for polymer components at the example of extrusion processes.
- name and explain relevant additional medical technology aspects, e.g. sterilisability or allergy potential, in material and process selection
- explain essential concepts of the finite element method and topology optimisation
- use the finite element software "Abaqus" for component design and evaluate simulation results with regard to informative value and load-bearing capacity
- carry out a topology optimisation with the software Tosca, interpret its results and derive structural concepts.
- successfully realise an individual development project in the area of additive manufacturing in a goal-oriented manner.
Organizational issues

Die Raumbelegung und der wöchentliche Veranstaltungstermin wird zu Beginn des Sommersemesters auf der Homepage des Instituts bekannt gegeben.

Aufgrund des gewünschten Betreuungsverhältnisses und der Institutsausstattung ist die maximale Anzahl der teilnehmenden Studierenden begrenzt. Die Anmeldung erfolgt über die Instituts-Homepage ab Anfang März.

Zusätzliche Übungen werden an weiteren fünf Terminen immer von 15:45 – 17:15 in R. 125, Geb. 70.04, Campus Ost stattfinden: 29.05., 06.06, 20.06., 27.06., 04.07.24.

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The room allocation and the weekly course dates are announced on the Institute's homepage at the beginning of the summer semester.

Due to the desired supervision ratio and the institute's equipment, the maximum number of participating students is limited.

Registration takes place via the Institute's homepage from the beginning of March.

Additional exercises will take place on 5 dates from 15:45 - 17:15 in room 125 at Building 70.04, Campus East: 29.05., 06.06, 20.06., 27.06., 04.07.24.
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-102812 - Major Field: Powertrain Systems

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**Events**

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

**Prerequisites**
none

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

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

**Content:**
In this course the different drive trains of mobile machinery will be discussed. The focus of this course is:
- mechanical gears
- torque converter
- hydrostatic drives
- power split drives
- electrical drives
- hybrid drives
- axles
- terra mechanics

**Media:** projector presentation

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

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

**Drive Train of Mobile Machines**
2113077, WS 23/24, 2 SWS, Language: German, Open in study portal
Content
In this course will be discussed the different drive train of mobile machinery. The focus of this course is:
- improve knowledge of fundamentals
- mechanical gears
- torque converter
- hydrostatic drives
- continuous variable transmission
- electrical 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
Course: Dynamic Systems of Technical Logistics [T-MACH-112113]

**Responsible:** Dr.-Ing. Martin Mittwollen

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102821 - Major Field: Technical Logistics

**Type:** Oral examination  
**Credits:** 6  
**Grading scale:** Grade to a third  
**Recurrence:** Each summer term  
**Version:** 1

### Competence Certificate

The assessment consists of an oral exam (approx. 20min) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

### Prerequisites

none

### Recommendation

Knowledge out of Basics of Technical Logistics-I (LV 2117095) preconditioned.

Knowledge out of Basics of Technical Logistics-II (LV 2117098) recommended.

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

**Dynamic Systems of Technical Logistics**  
2148605, SS 2024, 4 SWS, Language: German, Open in study portal  
Lecture / Practice (VÜ)  
On-Site

### Content

Conveyor technology = motion = dynamics  
Insight into the structure, mode of operation, dynamics and safety of materials handling equipment along the process chain of technical logistics from raw material extraction through processing, distribution, storage and order picking to shipping.  
Bulk material mining, transport, handling, storage  
Stability and tipping safety when turning, slewing, driving cranes  
Overhead cranes - structure, dynamics, safety  
Conveyors in material handling systems (belt, chain, AGV, EMS, ...)

### Organizational issues

DSTL und DSTL-P sind zeitlich so gegliedert, dass zunächst unter Hinzunahme des Donnerstags-Zeitslots für das Projekt ausschließlich der Vorlesungs- und Übungsteil bis ca. Ende Juni gehalten wird. Der anschließende Zeitraum ist ausschließlich für die (optionale) Projektarbeit vorgesehen.
8.60 Course: Dynamic Systems of Technical Logistics - Project [T-MACH-112114]

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

**Part of:** M-MACH-102821 - Major Field: Technical Logistics

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**Events**

| ST 2024 | 2148606 | Dynamic Systems of Technical Logistics - Project | 2 SWS | Project (P / 🗣️) | Mittwollen |

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

**Competence Certificate**

Presentation of performed project and defense (30min) according to §4 (2), No. 3 of the examination regulation

**Prerequisites**

T-MACH-112113 (Dynamic Systems of Technical Logistics) must have been started.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-112113 - Dynamic Systems of Technical Logistics must have been started.

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

**Dynamic Systems of Technical Logistics - Project**

2148606, SS 2024, 2 SWS, Language: German, [Open in study portal]

**Project (PRO)**  
On-Site

**Content**

Conveyor technology = motion = dynamics  
Course content:  
The knowledge acquired in the lecture DSTL will be extended and deepened together with the previous knowledge from GTL I/II in the context of an independent project work based on an application case from the current research and project work at IFL. Analyses, research, design work, calculations and simulations are used.

**Organizational issues**

DSTL und DSTL-P sind zeitlich so gegliedert, dass zunächst unter Hinzunahme des Mittwochs-Zeitslots für die Vorlesung ausschließlich der Vorlesungs- und Übungsteil bis ca. Ende Juni gehalten wird. Der anschließende Zeitraum ist ausschließlich für die (optionale) Projektarbeit vorgesehen.
8.61 Course: Dynamics of Electro-Mechanical Systems [T-MACH-111260]

**Responsible:** Philipp Altoé
Prof. Dr.-Ing. Alexander Fidlin

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics
- M-MACH-104442 - Major Field: Vibration Theory

**Type**
- Written examination

**Credits**
- 5

**Grading scale**
- Grade to a third

**Expansion**
- 1 terms

**Version**
- 2

**Events**

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

**Competence Certificate**
Written exam, 180 minutes

**Prerequisites**
None

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

**Dynamics of electro-mechanical systems**

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Cancelled

**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

**Organizational issues**
Die Vorlesung Dynamik elektromechanischer Systeme wird im Sommersemester 2024 nicht angeboten.
8.62 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-102812 - Major Field: Powertrain Systems
- M-MACH-102818 - Major Field: Vehicle Technology
- M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics
- M-MACH-104442 - Major Field: Vibration Theory

Events

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Competence Certificate
Oral examination, 30 min.

Prerequisites
none

Recommendation
Powertrain Systems Technology A: Automotive SystemsMachine Dynamics/Vibration Theory

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

Dynamics of the Automotive Drive Train
2163111, WS 23/24, 2 SWS, Language: German, Open in study portal

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

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

Übungen zu Dynamik des Kfz-Antriebsstrangs
2163112, WS 23/24, 2 SWS, Language: German, Open in study portal

Content
Exercises related to the lecture
8.63 Course: Elective Module - Subject, Body, Individual: the Other Side of Sustainability - Self Assignment BeNe [T-ZAK-112349]

Organisation:
Part of: M-ZAK-106099 - Supplementary Studies on Sustainable Development

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Competence Certificate
Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

Prerequisites
Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

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

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation
The content of the Basics Module is helpful.
8.64 Course: Elective Module - Sustainability Assessment of Technology - Self Assignment BeNe [T-ZAK-112348]

**Organisation:**
Part of: M-ZAK-106099 - Supplementary Studies on Sustainable Development

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**Competence Certificate**
Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

**Prerequisites**
Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

**Self service assignment of supplementary studies**
This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Recommendation**
The content of the Basics Module is helpful.
8.65 Course: Elective Module - Sustainability in Culture, Economy and Society - Self Assignment BeNe [T-ZAK-112350]

Organisation:
Part of: M-ZAK-106099 - Supplementary Studies on Sustainable Development

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Competence Certificate
Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

Prerequisites
Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

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

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation
The content of the Basics Module is helpful.
Course: Elective Module - Sustainable Cities and Neighbourhoods - Self Assignment BeNe [T-ZAK-112347]

Organisation: University

Part of: M-ZAK-106099 - Supplementary Studies on Sustainable Development

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**Competence Certificate**
Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

**Prerequisites**
Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

**Self service assignment of supplementary studies**
This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Recommendation**
The content of the Basics Module is helpful.
### 8.67 Course: Electrical Engineering and Electronics [T-ETIT-109820]

**Responsible:** Prof. Dr. Martin Doppelbauer  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-104801 - Electrical Engineering

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#### Events

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#### Exams

| WT 23/24 | 7306351 | Electrical Engineering and Electronics for Mechanical Engineers | Doppelbauer |
| ST 2024  | 7306351 | Electrical Engineering and Electronics for Mechanical Engineers | Becker |

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

**Annotation**

Exam will be held in german language
Course: Energy Efficient Intralogistic Systems [T-MACH-105151]

**Responsible:** Dr.-Ing. Meike Kramer  
Dr. Frank Schönung

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102812 - Major Field: Powertrain Systems  
M-MACH-102816 - Major Field: Fundamentals of Energy Technology  
M-MACH-102821 - Major Field: Technical Logistics

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**Competence Certificate**

Oral, 30 min. examination dates after the end of each lesson period.

**Prerequisites**

none

**Recommendation**

The content of course “Basics of Technical Logistics I” (T-MACH-109919) should be known.

**Annotation**

Visit the IFL homepage of the course for the course dates and/or possible limitations of course participation.

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

**Energy efficient intralogistic systems**

2117500, WS 23/24, 2 SWS, Language: German, Open in study portal

**Content**

The content of course “Basics of Technical Logistics” should be known.

**Organizational issues**

Blockveranstaltung 2022/2023. Die Veranstaltung findet in Präsenz statt

**Literature**

Keine.

**Responsible:** apl. Prof. Dr. Ron Dagan

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology

**Type**
- Oral examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each winter term

**Version**
- 2

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**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 23/24, 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.
8.70 Course: Engine Laboratory [T-MACH-105337]

**Responsible:** Dr.-Ing. Uwe Wagner

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102645 - Major Field: Combustion Engine Techniques
- M-MACH-102838 - Major Field: Energy Converting Engines

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**Events**

| ST 2024   | 2134001 | Engine Laboratory | 2 SWS | Practical course / 🗣 Wagner |

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:

**Organizational issues**

voraussichtlich 1. vorlesungsfreie Woche im SS 2021. Wird auf der Homepage und in den Vorlesungen bekannt gegeben

**Literature**

Versuchsbeschreibungen

Bachelor's Program Mechanical Engineering (B.Sc.), Date: 23/02/2024
Module Handbook, valid from Summer Term 2024
8.71 Course: Engine Measurement Techniques [T-MACH-105169]

Responsible: Dr.-Ing. Sören Bernhardt
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102645 - Major Field: Combustion Engine Techniques
M-MACH-102817 - Major Field: Information Technology
M-MACH-102818 - Major Field: Vehicle Technology

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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 2024, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

**Literature**

1. Grohe, H.: Messen an Verbrennungsmotoren
2. Bosch: Handbuch Kraftfahrzeugtechnik
3. Veröffentlichungen von Firmen aus der Meßtechnik
4. Hoffmann, Handbuch der Meßtechnik
5. Klingenberg, Automobil-Meßtechnik, Band C
8.72 Course: Engineering Mechanics I [T-MACH-100282]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke  
Dr.-Ing. Tom-Alexander Langhoff

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102572 - Engineering Mechanics  
M-MACH-104624 - Orientation Exam

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**Competence Certificate**

written exam, 90 min, graded

**Prerequisites**

successful participation in "Engineering Mechanics I (Tutorial)" (see T-MACH-100528)

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-100528 - Tutorial Engineering Mechanics I must have been passed.

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

**Engineering Mechanics I**

2161245, WS 23/24, 3 SWS, Language: German, Open in study portal

**Content**

- Basics of vector calculus
- Force systems
- Statics of rigid bodies
- Internal forces and moments in bars and beams
- Friction
- Centre of gravity, centre of mass
- Work, energy, principle of virtual work
- Statics of inextensible ropes
- Elastostatics of tension-compression bars

**Literature**

- Vorlesungsskript
- Hibbeler, R.C: Technische Mechanik 1 - Statik. Prentice Hall. Pearson Studium 2005
8.73 Course: Engineering Mechanics II [T-MACH-100283]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke
Dr.-Ing. Tom-Alexander Langhoff

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102572 - Engineering Mechanics
M-MACH-104624 - Orientation Exam

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**Competence Certificate**
written exam, 90 min, graded

**Prerequisites**
successful participation in "Engineering Mechanics II (Tutorial)" (see T-MACH-100284)

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

1. The course T-MACH-100284 - Tutorial Engineering Mechanics II must have been passed.

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

**Engineering Mechanics II**
2162250, SS 2024, 3 SWS, Language: German, Open in study portal

**Content**

- bending
- shear
- torsion
- stress and strain state in 3D
- Hooke's law in 3D
- elasticity theorems in 3D
- energy methods in elastostatics
- approximation methods
- stability of elastic bars

**Literature**
Vorlesungsskript

**Engineering Mechanics II (Lecture)**
3162010, SS 2024, 3 SWS, Language: English, Open in study portal
Content

- bending
- shear
- torsion
- stress and strain state in 3D
- Hooke's law in 3D
- elasticity theorems in 3D
- energy methods in elastostatics
- approximation methods
- stability of elastic bars
8.74 Course: Engineering Mechanics III & IV [T-MACH-105201]

**Responsible:** N.N.

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102572 - Engineering Mechanics

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**Competence Certificate**

Written Exam (3 h), graded

**Prerequisites**

Successful accomplishment of the exercise sheets in Engineering Mechanics III (T-MACH-105202) and of the exercise sheets in Engineering Mechanics IV (T-MACH-105203).

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-105202 - Tutorial Engineering Mechanics III must have been passed.
2. The course T-MACH-105203 - Tutorial Engineering Mechanics IV must have been passed.

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

**Engineering Mechanics III**

2161203, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Content**


Kinetics of a particle:
Newton's axiom, Principle of d'Alembert, work of a force, kinetic and potential energies, principle of linear momentum, principle of moment of momentum, kinetics in moving reference systems

Systems of particles:
Principle of center of mass, Principle of moment of momentum, impacts between particles, systems with variable mass, applications.

Plain motion of rigid bodies:
Organizational issues

Literature
Hibbeler: Technische Mechanik 3, Dynamik, München, 2006
Gross, Hauger, Schnell: Technische Mechanik Bd. 3, Heidelberg, 1983
Lehmann: Elemente der Mechanik III, Kinetik, Braunschweig, 1975
Göldner, Holzweissig: Leitfaden der Technischen Mechanik.

Hagedorn: Technische Mechanik III.

1. Engineering Mechanics III (Lecture)
   3161012, WS 23/24, 2 SWS, Language: English, Open in study portal

   Content
   Kinetics of a particle: Newton's axiom, principle of d'Alembert, work of force, kinetic and potential energies, principle of linear momentum, principle of moment of momentum, kinetics in moving reference systems
   Systems of particles: principle of center of mass, principle of moment of momentum, impacts between particles, systems with variable mass, applications

2. Engineering Mechanics IV
   2162231, SS 2024, 2 SWS, Language: German, Open in study portal

   Content
   Spatial kinematics of a rigid body, Euler angles, angular velocity using Euler angles, Euler's equations, inertia tensor, kinetic energy of a rigid body, free gyroscopes, forced gyroscopes, systems of rigid bodies, principle of d'Alembert, Lagrange's equations of the first and second kind, generalized coordinates, free and forced vibration of one degree of freedom systems, frequency response, vibration of multi degree of freedom systems, vibration absorption

Organizational issues

Literature
Hibbeler: Technische Mechanik 3, Dynamik, München, 2006
Marguerre: Technische Mechanik III, Heidelberger Taschenbücher, 1968

3. Engineering Mechanics 4
   3162012, SS 2024, 2 SWS, Language: English, Open in study portal

   Lecture (V) On-Site

   Blended (On-Site/Online)
Content
The students know some possibilities to describe the position and orientation of a rigid body for an arbitrary 3d motion. They realize that the rotational velocity is a vector which may change both magnitude and orientation. They can apply the principle of linear momentum and the principle of moment of momentum to a spatial motion of a rigid body and notice that this is much more complicated compared to a plain motion. The students can calculate the coordinates of the inertia tensor. They see that many effects which may be seen with gyroscopes can be explained by the principle of moment of momentum. For systems with many particles or bodies but only few degrees of freedom the students know that the application of analytical methods like the principle of D'Alembert in Lagrangian form or the Lagrange equations may be advantageous. They can apply these principles to simple problems. For vibration problems the students can interpret the most important expressions like eigenfrequency, resonance or eigenvalue problem. Forced vibration of systems with the degree of freedom can be investigated by the students.
### 8.75 Course: Exercises in Technical Thermodynamics and Heat Transfer I [T-MACH-105204]

**Responsible:** Prof. Dr. Ulrich Maas  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102574 - Technical Thermodynamics

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<td>Exercises in Technical Thermodynamics and Heat Transfer I</td>
<td>Maas, Schießl</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**  
Successful completion of written preliminary tests.

**Prerequisites**  
one
8.76 Course: Excercises in Technical Thermodynamics and Heat Transfer II [T-MACH-105288]

**Responsible:** Prof. Dr. Ulrich Maas  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102574 - Technical Thermodynamics

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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**
Successful completion of written preliminary tests.

**Prerequisites**
none

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

**Technical Thermodynamics and Heat Transfer II (Tutorial)**
2166556, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Practice (Ü)**
On-Site

**Content**
Calculation of thermodynamical problems

**Literature**

- Vorlesungsskriptum
8.77 Course: Exercices - Tribology [T-MACH-109303]

**Responsible:** Prof. Dr. Martin Dienwiebel  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102812 - Major Field: Powertrain Systems

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**Events**

| WT 23/24 | 2181114 | Tribology | 5 SWS | Lecture / Practice ( / ) | Dienwiebel, Scherge |

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 23/24, 5 SWS, Language: German, Open in study portal | Lecture / Practice (VÜ) | On-Site |
Content

- Chapter 1: Friction
  - Friction, contact, 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, dissipative 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

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

**Responsible:** Dr.-Ing. Jens Gibmeier  
Prof. Dr. Reinhard Schneider

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

### Events

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<td>Materials Characterization</td>
<td>2 SWS</td>
<td>Lecture / 🗣️</td>
<td>Gibmeier, Peterlechner</td>
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<tr>
<td>ST 2024 2174988</td>
<td>Tutorials and lab courses for &quot;materials characterization&quot;</td>
<td>1 SWS</td>
<td>Practice / 🗣️</td>
<td>Gibmeier, Peterlechner</td>
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</table>

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:

#### V Materials Characterization

2174586, SS 2024, 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.

**Literature**

Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Lituratur wird zu Beginn der Veranstaltung bekanntgegeben.

#### V Tutorials and lab courses for "materials characterization"

2174988, SS 2024, 1 SWS, Language: German, [Open in study portal](#)

**Content**

s. lecture "materials characterization" (V-No. 2174586)

**Organizational issues**

Die Termine und der Ort zu den Übungen und Laborbesuche zur Vorlesung Werkstoffanalytik (V-Nr. 2174586) werden in der Vorlesung bekanntgegeben.

The dates and locations of the tutorials and lab courses for the lecture materials characterization (V-No. 2174586) will be announced in one of the first lectures.

**Literature**

Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Lituratur wird zu Beginn der Veranstaltung bekanntgegeben.
8.79 Course: Experimental Dynamics [T-MACH-105514]

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

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

Events

| ST 2024  | 2162225 | Experimental Dynamics | 3 SWS | Lecture / x | Fidlin |
| ST 2024  | 2162228 | Übungen zu Experimentelle Dynamik | 2 SWS | Practice / x | Fidlin, Genda |

Exams

| WT 23/24 | 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 2024, 3 SWS, Language: German, Open in study portal

Lecture (V)
Cancelled

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

Organizational issues
Die Vorlesung Experimentelle Dynamik wird im Sommersemester 2024 nicht angeboten.
8.80 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-102819 - Major Field: Materials Science and Engineering

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Events

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<th>2182572</th>
<th>Failure Analysis</th>
<th>2 SWS</th>
<th>Lecture / 🗣</th>
<th>Greiner, Schneider</th>
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Exams

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<tr>
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<th>76-T-MACH-105724</th>
<th>Failure Analysis</th>
</tr>
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</table>

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 23/24, 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

Literature
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-102812 - Major Field: Powertrain Systems
M-MACH-102819 - Major Field: Materials Science and Engineering

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

Events
| WT 23/24 | 2181711 | Failure of structural materials: deformation and fracture | 3 SWS | Lecture / Practice (VÜ) | Gumbsch, Weygand |

Exams
| WT 23/24 | 76-T-MACH-102140 | Failure of Structural Materials: Deformation and Fracture | Weygand, Gumbsch, Kraft |
| ST 2024 | 76-T-MACH-102140 | Failure of Structural Materials: Deformation and Fracture | Weygand, Gumbsch |

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:

| V | Failure of structural materials: deformation and fracture | Lecture / Practice (VÜ) |
|   | 2181711, WS 23/24, 3 SWS, Language: German, Open in study portal | 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
# 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

### Course Information

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

### Events

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| WT 23/24| 2181715        | Failure of Structural Materials: Fatigue and Creep | 2  | German   | Lecture / 🗣️

**Exams**

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<td>Failure of Structural Materials: Fatigue and Creep</td>
<td>Gruber, Gumbsch</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:**

### Failure of Structural Materials: Fatigue and Creep

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<td>German</td>
<td>Lecture (V)</td>
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</table>

**Lecture (V)**  
**On-Site**
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
8.83 Course: Fatigue of Materials [T-MACH-112106]

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

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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**Events**

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Legend: 🤖 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ⏳ Cancelled

**Competence Certificate**

Oral exam, about 20 minutes

**Prerequisites**

None

**Recommendation**

Basic knowledge in Materials Science will be helpful.

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

<table>
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<tr>
<th>Fatigue of Materials</th>
<th>Lecture (V)</th>
<th>On-Site</th>
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<tbody>
<tr>
<td>2173586, SS 2024, 2 SWS, Language: German</td>
<td>Open in study portal</td>
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</tbody>
</table>

**Content**

- Introduction: historical review and some fatigue damage cases
- Cyclic Stress Strain Behaviour
- Crack Initiation
- Crack Propagation
- Lifetime Behaviour under Cyclic Loading
- Fatigue of Notched Components
- Structural Durability
- Fatigue of composites and compound materials

**learning objectives:**

The students are able to recognise the deformation and the failure behaviour of materials under cyclic loading and to assign it to the basic microstructural processes. They know the sequence and the development of fatigue damages and can evaluate the initiation and the growth of fatigue cracks.

The students can evaluate the cyclic strength behaviour of materials and components both qualitatively and quantitatively and know the procedures for the assessment of single-stage, multistage and stochastic cyclical loadings.

**requirements:**

None, basic knowledge in Material Science will be helpful

**workload:**

- Regular attendance: 21 hours
- Self-study: 99 hours

**Literature**

Ein Manuskript, das auch aktuelle Literaturhinweise enthält, wird in der Vorlesung verteilt.
8.84 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-102816 - Major Field: Fundamentals of Energy Technology

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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**

oral exam, 20 min

**Prerequisites**

none
Below you will find excerpts from events related to this course:

### Fluid Mechanics II

**2153512, WS 23/24, 3 SWS, Language: German, Open in study portal**

**Lecture / Practice (VÜ) On-Site**

**Content**

The students know how to derive the fundamental equations for mass and momentum conservation and can introduce material laws for fluids into those. They can discuss the physical meaning of the different terms in the Navier-Stokes-Equations. They are capable of simplifying the mathematical equations that describe the motion of fluids and can compute flow quantities for generic problems based on these simplified equations. This includes the calculation of static and dynamic forces acting from the fluid onto the solid as well as the detailed analysis of two-dimensional viscous flows.

- tensor notation, fluid elements in continuum, Reynolds transport theorem, conservation of mass and momentum, continuity equation, constitutive law for Newtonian fluids, Navier-Stokes equations, angular momentum and energy conservation, integral form of the conservation equations, forces between fluids and solids, analytical solutions of the Navier-Stokes equations

**Literature**


Content
The students know how to derive the fundamental equations for mass and momentum conservation and can introduce material laws for fluids into those. They can discuss the physical meaning of the different terms in the Navier-Stokes-Equations. They are capable of simplifying the mathematical equations that describe the motion of fluids and can compute flow quantities for generic problems based on these simplified equations. This includes the calculation of static and dynamic forces acting from the fluid onto the solid as well as the detailed analysis of two-dimensional viscous flows.

Literature

Fluid Mechanics I
2154512, SS 2024, 3 SWS, Language: German, Open in study portal

Content
Properties of fluids, surface tension, hydro- and aerostatics, kinematics, stream tube theory (compressible and incompressible), losses in pipeline systems, dimensional analysis, dimensionless numbers

Literature

Fluid Mechanics I
3154510, SS 2024, 3 SWS, Language: English, Open in study portal

Content
Properties of fluids, surface tension, hydro- and aerostatics, kinematics, stream tube theory (compressible and incompressible), losses in pipeline systems, dimensional analysis, dimensionless numbers

Literature
8.86 Course: Fluid Power Systems [T-MACH-102093]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102746 - Compulsory Elective Module
- M-MACH-102838 - Major Field: Energy Converting Engines

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**Events**

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<th>Date</th>
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**Exams**

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<td>WS 23/24</td>
<td>Fluid Power Systems</td>
<td>Lecture</td>
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<td>Geimer</td>
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**Legend:** 🌐 Online, 🧩 Blended (On-Site/Online), 🔗 On-Site, ❌ Cancelled

**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 23/24, 2 SWS, Language: German, Open in study portal

**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
8.87 Course: Foundry Technology [T-MACH-105157]

Responsible: Dr.-Ing. Christian Wilhelm
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102819 - Major Field: Materials Science and Engineering

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<td>Each summer term</td>
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Events

| ST 2024 | 2174575 | Foundry Technology | 2 SWS | Lecture / 🗣 | Schulze, Dietrich |

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

Competence Certificate
oral exam; about 25 minutes

Prerequisites
M-MACH-102562 - Materials Science must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-MACH-102562 - Materials Science must have been passed.

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

Foundry Technology
2174575, SS 2024, 2 SWS, Language: German, Open in study portal

Literature
Literaturhinweise werden in der Vorlesung gegeben
Reference to literature, documentation and partial lecture notes given in lecture
8.88 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-102645 - Major Field: Combustion Engine Techniques
M-MACH-102838 - Major Field: Energy Converting Engines

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Exams

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<td>On-Site</td>
<td>4</td>
<td>Grade to a third</td>
<td>Kehrwald</td>
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</table>

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 23/24, 2 SWS, Language: German, Open in study portal

Lecture (V) On-Site

Content
electric drives and fuel cell drives with the associated operating materials will also be presented

- Introduction, basics, primary energy and energy chains
- Illustrative chemistry of hydrocarbons
- Fossil fuels, exploration, processing, standards
- Operating materials not fossil, renewable, alternative
- Fuels, lubricants, coolants, AdBlue
- Laboratory analysis, testing, test benches and measurement technology
- Excursion to test fields for motorized drives from 0.5 to 3,500 kW

Literature

Skript
8.89 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-102815 - Major Field: Engineering Design
- M-MACH-102818 - Major Field: Vehicle Technology

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<td>Fundamentals for Design of Motor-Vehicles Bodies I</td>
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**Legend:** 🖥 Online, 🏭 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Oral group examination

Duration: 30 minutes

Auxiliary means: none

**Prerequisites**

none

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

**Fundamentals for Design of Motor-Vehicles Bodies I**

2113814, WS 23/24, 1 SWS, Language: German, Open in study portal

**Lecture (V)**

On-Site

**Content**

1. History and design
2. Aerodynamics
3. Design methods (CAD/CAM, FEM)
4. Manufacturing methods of body parts
5. Fastening 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**

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

Termine und nähere Informationen: siehe ILIAS oder Institutshomepage

Dates and further information will be published on the homepage of the institute.
Literature
1. Automobiltechnische Zeitschrift ATZ, Friedr. Vieweg & Sohn Verlagsges. mbH, Wiesbaden
2. Automobil Revue, Bern (Schweiz)
3. Automobil Produktion, Verlag Moderne Industrie, Landsberg
8.90 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-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology

Type: Oral examination  Credits: 2  Grading scale: Grade to a third  Recurrence: Each summer term  Version: 1

Events

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<td>2114840</td>
<td>Fundamentals for Design of Motor-Vehicles Bodies II</td>
<td>1 SWS</td>
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<td>Each summer term</td>
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Exams

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<td>Lecture</td>
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<td>Each summer term</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 for Design of Motor-Vehicles Bodies II

2114840, SS 2024, 1 SWS, Language: German, Open in study portal

Lecture (V)  On-Site

Content

1. Body properties/testing procedures
2. External body-parts
3. Interior trim
4. Compartment air conditioning
5. Electric and electronic features
6. Crash tests
7. Project management aspects, future prospects

Learning Objectives:

The students know that, often the design of seemingly simple detail components can result in the solution of complex problems. They have knowledge in testing procedures of body properties. They have an overview of body parts such as bumpers, window lift mechanism and seats. They understand, as well as, parallel to the normal electrical system, about the electronic side of a motor vehicle. Based on this they are ready to analyze and to judge the relation of these single components. They are also able to contribute competently to complex development tasks by imparted knowledge in project management.

Organizational issues

Voraussichtliche Termine, nähere Informationen und evtl. Änderungen:
siehe Instituts homepage.

Scheduled dates, further information and possible changes of date:
see homepage of the institute.

Literature

1. Automobiltechnische Zeitschrift ATZ, Friedr. Vieweg & Sohn Verlagsges. mbH, Wiesbaden
2. Automobil Revue, Bern (Schweiz)
3. Automobil Produktion, Verlag Moderne Industrie, Landsberg
8.91 Course: Fundamentals in the Development of Commercial Vehicles [T-MACH-111389]

**Responsible:** Christof Weber  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102815 - Major Field: Engineering Design  
M-MACH-102818 - Major Field: Vehicle Technology

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**Type**  
Oral examination

**Credits**  
4

**Grading scale**  
Grade to a third

**Recurrence**  
see Annotations

**Expansion**  
2 terms

**Version**  
2

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**Events**

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<td>Fundamentals in the Development of Commercial Vehicles I</td>
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**Competence Certificate**

Oral group examination  
Duration: appr. 30 minutes  
Auxiliary means: none

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**Prerequisites**

none

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**Annotation**

Fundamentals in the Development of Commercial Vehicles I, WT  
Fundamentals in the Development of Commercial Vehicles II, ST

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

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

2113812, WS 23/24, 1 SWS, Language: German, Open in study portal

**Content**

1. Introduction, definitions, history  
2. Development tools  
3. Complete vehicle  
4. Cab, bodyshell work  
5. Cab, interior fitting  
6. Alternative drive systems  
7. Drive train  
8. Drive system diesel engine  
9. Intercooled diesel engines

**Learning Objectives:**

The students have proper knowledge about the process of commercial vehicle development starting from the concept and the underlying original idea to the real design. They know that the customer requirements, the technical realisability, the functionality and the economy are important drivers.

The students are able to develop parts and components. Furthermore they have knowledge about different cab concepts, the interior and the interior design process. Consequently they are ready to analyze and to judge concepts of commercial vehicles as well as to participate competently in the commercial vehicle development.
Organizational issues
Das Vorlesungsmaterial wird auf ILIAS bereitgestellt. Das ILIAS-Passwort erhalten Sie unter https://fast-web-01.fast.kit.edu/PasswoerterIlias/

Termine und Nähere Informationen: siehe ILIAS oder Institutshomepage

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

Literature

Fundamentals in the Development of Commercial Vehicles II
2114844, SS 2024, 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 sowie nähere Informationen und eventuelle Terminänderungen:
siehe Institutshomepage.

Literature
1. HILGERS, M.: Nutzfahrzeugtechnik lernen, Springer Vieweg, ISSN: 2510-1803
**8.92 Course: Fundamentals of Automobile Development I [T-MACH-105162]**

**Responsible:** Prof.Dipl.-Ing. Rolf Frech  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:**  
M-MACH-102815 - Major Field: Engineering Design  
M-MACH-102818 - Major Field: Vehicle Technology

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**Competence Certificate**  
Written examination  
Duration: 90 minutes  
Auxiliary means: none  
Prerequisites: none

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

**Fundamentals of Automobile Development I**  
2113810, WS 23/24, 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**  
Das Vorlesungsmaterial wird auf ILIAS bereitgestellt. Das ILIAS-Passwort erhalten Sie unter https://fast-web-01.fast.kit.edu/Passwoerterilias/  
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.
The scriptum will be provided during the first lessons

**Principles of Whole Vehicle Engineering I**

<table>
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**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**

You will find the lecture material on ILIAS. To get the ILIAS password, KIT students refer to [https://fast-web-01.fast.kit.edu/Passwoerterliias/](https://fast-web-01.fast.kit.edu/Passwoerterliias/)

Termine und nähere Informationen finden Sie auf der Institutshomepage.

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
8.93 Course: Fundamentals of Automobile Development II [T-MACH-105163]

**Responsible:** Prof. Dipl.-Ing. Rolf Frech  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:**  
- M-MACH-102815 - Major Field: Engineering Design  
- M-MACH-102818 - Major Field: Vehicle Technology

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<tr>
<td>ST 2024</td>
<td>2114842</td>
<td>Principles of Whole Vehicle Engineering II</td>
<td>1</td>
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<td>08:00-11:00</td>
<td>02.05.</td>
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<td>2114860</td>
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**Exams**

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<th>Course Title</th>
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<th>Professor</th>
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<tr>
<td>WT 23/24</td>
<td>76-T-MACH-105163</td>
<td>Fundamentals of Automobile Development II</td>
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<td>ST 2024</td>
<td>76-T-MACH-105163</td>
<td>Fundamentals of Automobile Development II</td>
<td>1</td>
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</table>

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:

**Principles of Whole Vehicle Engineering II**

2114842, SS 2024, 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 an folgenden Terminen statt: 02.05., 16.05., 06.06. 2024, jeweils von 08:00 bis 11:00 Uhr.  
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 2024, 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
Veranstaltung findet als Blockvorlesung an folgenden Terminen statt: 02.05., 16.05., 06.06.2024 von 11:15 bis 14:00 Uhr.

Scheduled dates:
see homepage of the institute.

Kann nicht mit der Veranstaltung [2114842] kombiniert werden.

Cannot be combined with lecture [2114842].

Literature
Das Skript zur Vorlesung ist über ILIAS verfügbar.
8.94 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-102645 - Major Field: Combustion Engine Techniques
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102838 - Major Field: Energy Converting Engines

<table>
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Events

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<td>Fundamentals of catalytic exhaust gas aftertreatment</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:

Fundamentals of catalytic exhaust gas aftertreatment
2134138, SS 2024, 2 SWS, Language: German, Open in study portal

Organizational issues
Blockvorlesung, Termin und Ort werden auf Ilias sowie der Homepage des IFKM und ITCP bekannt gegeben.

Literature
Skript, erhältlich in der Vorlesung

**8.95 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-102746 - Compulsory Elective Module
- M-MACH-102816 - Major Field: Fundamentals of Energy Technology
- M-MACH-102818 - Major Field: Vehicle Technology
- M-MACH-102838 - Major Field: Energy Converting Engines

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**Events**

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**Exams**

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**Competence Certificate**
written exam, 60 min.

**Prerequisites**
none

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

1. The course T-MACH-112799 - Fundamentals of Combustion Engine Technology must not have been started.

**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
8.96 Course: Fundamentals of Combustion Engine Technology [T-MACH-112799]

**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-102645 - Major Field: Combustion Engine Techniques

<table>
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<td>Fundamentals of Combustion Engine Technology Kubach</td>
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**Competence Certificate**
oral exam, 30 min

**Prerequisites**
none

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

1. The course T-MACH-105652 - Fundamentals of Combustion Engine Technology must not have been started.
8.97 Course: Fundamentals of Combustion I [T-MACH-105213]

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

Part of: M-MACH-102746 - Compulsory Elective Module
M-MACH-102838 - Major Field: Energy Converting Engines

<table>
<thead>
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<th>Recurrence</th>
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<td>Fundamentals of Combustion I</td>
<td>2 SWS</td>
<td>Lecture / 🗣</td>
<td>Maas, Shrotriya, Zenk</td>
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<td>Fundamentals of Combustion I (Tutorial)</td>
<td>1 SWS</td>
<td>Practice / 🗣</td>
<td>Bykov</td>
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<td>2 SWS</td>
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Exams

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<td>Fundamentals of Combustion I - english exam</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

Competence Certificate
Written exam, approx. 3 hours

Prerequisites
none

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

Fundamentals of Combustion I
2165515, WS 23/24, 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

Organizational issues
Bei zu wenigen Hörsern wird die Lehrveranstaltung mit der englischen Lehrveranstaltung zusammengelegt.

Literature
Vorlesungsskript,

Fundamentals of Combustion I (Tutorial)
2165517, WS 23/24, 1 SWS, Language: German, Open in study portal

Practice (Ü)
Fundamentals of Combustion I
3165016, WS 23/24, 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
8 COURSES

8.98 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-102816 - Major Field: Fundamentals of Energy Technology
M-MACH-102838 - Major Field: Energy Converting Engines

<table>
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Events

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<td>ST 2024 2166538</td>
<td>2 SWS</td>
<td>Fundamentals of combustion II</td>
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<tr>
<td>ST 2024 2166539</td>
<td>1 SWS</td>
<td>Übung zu Grundlagen der technischen Verbrennung II</td>
<td>Practice / On-Site</td>
<td>Maas</td>
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<td>ST 2024 3166550</td>
<td>2 SWS</td>
<td>Fundamentals of Combustion II</td>
<td>Lecture / On-Site</td>
<td>Maas, Bykov, Shrotriya</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:

Fundamentals of combustion II

2166538, SS 2024, 2 SWS, Language: German, 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

Literature

Vorlesungsskript;

Übung zu Grundlagen der technischen Verbrennung II

2166539, SS 2024, 1 SWS, Language: German, Open in study portal

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 2024, 2 SWS, Language: English, Open in study portal

Content

- Three dimensional Navier-Stokes equations for reacting flows
- Tubulent reactive flows
- Turbulent non-premixed flames
- Turbulent premixed flames
- Combustion of liquid and solid fuels
- Engine knock
- Thermodynamics of combustion processes
- Transport phenomena
- Effects of Combustion Processes on the Atmosphere

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

Literature
Vorlesungskript;
8.99 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-102816 - Major Field: Fundamentals of Energy Technology

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**Events**

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<td>2024-03-28</td>
<td>Lecture</td>
<td>Fundamentals of Energy Technology</td>
<td>Cheng, Badea</td>
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<td>ST 2024 3190923</td>
<td>2024-03-31</td>
<td>Lecture</td>
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**Exams**

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</table>

**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 2024, 3 SWS, Language: German, Open in study portal**

**Lecture (V)**  
**On-Site**

**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
8 COURSES

Course: Gear Cutting Technology [T-MACH-102148]

Responsible: Hon.-Prof. Dr. Markus Klaiber
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102812 - Major Field: Powertrain Systems
- M-MACH-102815 - Major Field: Engineering Design
- M-MACH-102818 - Major Field: Vehicle Technology

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

Events

<table>
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<th>Index</th>
<th>Title</th>
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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

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

Content
Based on the gearing theory, manufacturing processes and machine technologies for producing gearings, the needs of modern gear manufacturing will be discussed in the lecture. For this purpose, various processes for various gear types are taught which represent the state of the art in practice today. A classification in soft and hard machining and furthermore in cutting and non-cutting technologies will be made. For comprehensive understanding the processes, machine technologies, tools and applications of the manufacturing of gearings will be introduced and the current developments presented. For assessment and classification of the applications and the performance of the technologies, the methods of mass production and manufacturing defects will be discussed. Sample parts, reports from current developments in the field of research and an excursion to a gear manufacturing company round out the lecture.

Learning Outcomes:
The students …

- can describe the basic terms of gearings and are able to explain the imparted basics of the gearwheel and gearing theory.
- are able to specify the different manufacturing processes and machine technologies for producing gearings. Furthermore they are able to explain the functional principles and the dis-/advantages of these manufacturing processes.
- can apply the basics of the gearing theory and manufacturing processes on new problems.
- are able to read and interpret measuring records for gearings. are able to make an appropriate selection of a process based on a given application
- can describe the entire process chain for the production of toothed components and their respective influence on the resulting workpiece properties.

Workload:
regular attendance: 21 hours
self-study: 99 hours
**Literature**

**Medien:**
Skript zur Veranstaltung wird über [https://ilias.studium.kit.edu/](https://ilias.studium.kit.edu/) bereitgestellt.

**Media:**
Lecture notes will be provided in Ilias [https://ilias.studium.kit.edu/](https://ilias.studium.kit.edu/).
**Course: Großdiesel- und -gasmotoren für Schiffsantriebe [T-MACH-110816]**

- **Responsible:** Dr.-Ing. Heiko Kubach
- **Organisation:** Part of: M-MACH-102645 - Major Field: Combustion Engine Techniques
  M-MACH-102838 - Major Field: Energy Converting Engines

**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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<th>Large Diesel and Gas Engines for Ship Propulsions</th>
<th>2 SWS</th>
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Legend: 🖥 Online, 🕰 Blended (On-Site/Online), 🔭 On-Site, x Cancelled

**Competence Certificate**
oral exam, 20 minutes

**Prerequisites**
None

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

**Large Diesel and Gas Engines for Ship Propulsions**
2134154, SS 2024, 2 SWS, Language: German, Open in study portal

**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

**Organizational issues**
8.102 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-102818 - Major Field: Vehicle Technology

<table>
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Exams

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

Competence Certificate
Verbally

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

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

Handling Characteristics of Motor Vehicles I
2113807, WS 23/24, 2 SWS, Language: German, Open in study portal

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, program 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.

Organizational issues
Die Vorlesung wird als Videostream zur Verfügung gestellt. Sie finden den Videostream und das Vorlesungsmaterial auf ILIAS. Das ILIAS-Passwort erhalten Sie unter https://fast-web-01.fast.kit.edu/PasswoerterIlias/

Literature


8.103 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-102818 - Major Field: Vehicle Technology

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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 2024, 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.

**Organizational issues**

Die Vorlesung wird als Videostream zur Verfügung gestellt. Sie finden den Videostream und das Vorlesungsmaterial auf ILIAS. Das ILIAS-Passwort erhalten Sie unter https://fast-web-01.fast.kit.edu/PasswoerterILIAS/

**Literature**


Bachelor's Program Mechanical Engineering (B.Sc.), Date: 23/02/2024
Module Handbook, valid from Summer Term 2024
8.104 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-102746 - Compulsory Elective Module

Type
Written examination

Credits
4

Grading scale
Grade to a third

Recurrence
Each term

Version
1

Events

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

Competence Certificate

Written exam, approx. 3 h

Prerequisites

none

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

Heat and mass transfer

2165512, WS 23/24, 2 SWS, Language: German, 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

Literature

- Maas ; Vorlesungsskript "Wärme- und Stoffübertragung"

Heat and Mass Transfer

3122512, SS 2024, 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; Vorlesungs-skript "Wärme- und Stoffübertragung"
- Baehr, H.-D., Stephan, K.: "Wärme- und Stoffübertragung". Springer Verlag, 1993
8.105 Course: Human Factors Engineering I [T-MACH-105518]

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

Part of: M-MACH-102589 - Major Field: Production Systems

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

Competition 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 23/24, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The course "Human Factors Engineering I: Ergonomics" takes place in the first half of the semester on Wednesday and Thursday.

In the second half of the semester 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
- schriftliche Prüfung
- Die Vorlesung hat einen Arbeitsaufwand von 120 h (=4 LP).
Mit einer gültigen KIT-Mail-Adresse können Sie das Passwort bei elisabeth.schlund@kit.edu schriftlich erfragen.

Literature
Die Kursmaterialien stehen auf ILIAS zum Download zur Verfügung.
8.106 Course: Human Factors Engineering II [T-MACH-105519]

**Responsible:** Prof. Dr.-Ing. Barbara Deml

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102589 - Major Field: Production Systems

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

**Competence Certificate**

written exam, 60 minutes

The exams are only offered in German!

**Prerequisites**

none

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

**Human Factors Engineering II: Work Organisation**

2109036, WS 23/24, 2 SWS, Language: German, Open in study portal

Lecture (V) On-Site
Content
The course "Human Factors Engineering I: Ergonomics" takes place in the first half of the semester on Wednesday and Thursday.

In the second half of the semester 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
Die Veranstaltung "Arbeitswissenschaft I: Ergonomie" findet in der ersten Hälfte des Semesters am Mittwoch und Donnerstag statt.

In der zweiten Hälfte, ab dem Donnerstag, dem 21.12.2023 findet die Veranstaltung "Arbeitswissenschaft II: Arbeitsorganisation" am Mittwoch und Donnerstag statt.

- schriftliche Prüfung
- Die Vorlesung hat einen Arbeitsaufwand von 120 h (=4 LP).

**Mit einer gültigen KIT-E-Mail-Adresse können Sie das Passwort bei elisabeth.schlund@kit.edu schriftlich erfragen.**

Literature
Die Kursmaterialien stehen auf ILIAS zum Download zur Verfügung.
### Course: Human-Machine-Interaction [T-INFO-101266]

**Responsible:** Prof. Dr.-Ing. Michael Beigl  
**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-102820 - Major Field: Mechatronics

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**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.

**Responsible:** Prof. Dr.-Ing. Michael Beigl

**Organisation:** KIT Department of Informatics

**Part of:** M-MACH-102820 - Major Field: Mechatronics

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
# 8.109 Course: Hybrid and Electric Vehicles [T-ETIT-100784]

**Responsible:** Prof. Dr. Martin Doppelbauer  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:**  
M-MACH-102812 - Major Field: Powertrain Systems  
M-MACH-102818 - Major Field: Vehicle Technology  
M-MACH-102820 - Major Field: Mechatronics

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

**Prerequisites**

none
8.110 Course: Hydraulic Fluid Machinery [T-MACH-105326]

**Responsible:** Dr. Balazs Pritz

**Organisation:** KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery

**Part of:**
- M-MACH-102816 - Major Field: Fundamentals of Energy Technology
- M-MACH-102838 - Major Field: Energy Converting Engines

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

**Competence Certificate**
oral exam, 40 min.

**Prerequisites**
None.

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

**Hydraulic Fluid Machinery**

2157432, SS 2024, 4 SWS, Language: German, [Open in study portal](#)

**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

**Recommendations:**

3154510 – Fluid Mechanics I
3153511 – Fluid Mechanics II

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. Buhl, W.: Strömungsmaschinen I & II, Vogel-Verlag
5. Carolus, T.: Ventilatoren, Teubner-Verlag
6. Kreiselpumpenlexikon, KSB Aktiengesellschaft
7. Zierep, J., Bühler, K.: Grundzüge der Strömungslehre, Teubner-Verlag
8.111 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-102818 - Major Field: Vehicle Technology
M-MACH-102838 - Major Field: Energy Converting Engines

<table>
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<td>Each winter term</td>
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Events
WT 23/24 2134155 Hydrogen and reFuels - Energy Conversion in Combustion Engines 2 SWS Lecture / Koch

Exams
WT 23/24 7600092 Hydrogen and reFuels - Energy Conversion in Combustion Engines Koch

Competence Certificate
oral exam, appr. 25 minutes, no auxiliary means

Prerequisites
none

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

Hydrogen and reFuels - Energy Conversion in Combustion Engines
2134155, WS 23/24, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
New types of CO2-neutral fuels such as gaseous hydrogen but also liquid synthetic fuels often place specific requirements on engine systems that differ significantly from operation with conventional fuels. These special aspects of engine energy conversion are dealt with in this lecture.

Introduction
Thermodynamics of combustion engines
Fundamentals
gas exchange
Flow field
Wall heat losses
Combustion in gasoline engines
Pressure Trace Analysis
Combustion in Diesel engines
Specific Topics of Hydrogen Combustion
Waste heat recovery
8.112 Course: I4.0 Systems Platform [T-MACH-106457]

**Responsible:** Dipl.-Ing. Thomas Maier  
Prof. Dr.-Ing. Jivka Ovtcharova  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-102583 - Major Field: Information Management

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**Events**

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<td>I4.0 Systems platform</td>
<td>4 SWS</td>
<td>Project (P / 🗣️)</td>
<td>Ovtcharova, Maier</td>
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**Exams**

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<td>I4.0 Systems platform</td>
<td>4 SWS</td>
<td>Project (P / 🗣️)</td>
<td>Ovtcharova</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, ✗ Cancelled

**Competence Certificate**

Alternative exam assessment (project work)

**Prerequisites**

None

**Annotation**

Limited number of participants.

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

**I4.0 Systems platform**

<table>
<thead>
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**Content**

Industry 4.0, IT systems for fabrication (e.g.: CAx, PDM, CAM, ERP, MES), process modelling and execution, project work in teams, practice-relevant I4.0 problems, in automation, manufacturing industry and service.

Students can

- describe the fundamental concepts, challenges, and objectives of Industrie 4.0 and name the essential terms in context of information management
- explain the necessary information flow between the different IT systems. They get practically knowledge about using current IT systems in context of I4.0, from order to production.
- 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

**I4.0 Systems platform**

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Content
Industry 4.0, IT systems for fabrication (e.g.: CAx, PDM, CAM, ERP, MES), process modelling and execution, project work in teams, practice-relevant I4.0 problems, in automation, manufacturing industry and service.

Students can

• describe the fundamental concepts, challenges, and objectives of Industrie 4.0 and name the essential terms in context of information management
• explain the necessary information flow between the different IT systems. They get practically knowledge about using current IT systems in context of I4.0, from order to production.
• 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
# 8.113 Course: Ignition Systems [T-MACH-105985]

**Responsible:** Dr.-Ing. Olaf Toedter  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102645 - Major Field: Combustion Engine Techniques  
- M-MACH-102838 - Major Field: Energy Converting Engines

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### Events

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<td>Ignition systems</td>
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<td>Lecture / On-Site</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:

**Ignition systems**

- 2133125, WS 23/24, 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 and Alternative Ignition Systems
8.114 Course: In-depth Module - Doing Culture - Self Assignment BAK [T-ZAK-112655]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

<table>
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Competence Certificate
At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).
In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.
The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization.
In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

Prerequisites
Prerequisite for the ‘Oral Examination’ is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

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

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Annotation
The content of the Basic Modul is helpful.
8.115 Course: In-depth Module - Global Cultures - Self Assignment BAK [T-ZAK-112658]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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**Competence Certificate**
At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).
In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.
The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization.
In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

**Prerequisites**
Prerequisite for the ‘Oral Examination’ is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

**Self service assignment of supplementary stdues**
This course can be used for self service assignment of grade acquired from the following study providers:
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Annotation**
The content of the Basic Modul is helpful.
8.116 Course: In-depth Module - Media & Aesthetics - Self Assignment BAK [T-ZAK-112656]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

Type
Examination of another type

Credits
3

Grading scale
Grade to a third

Version
1

Competence Certificate
At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).
In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.
The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization.
In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

Prerequisites
Prerequisite for the ‘Oral Examination’ is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

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

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Annotation
The content of the Basic Modul is helpful.
8.117 Course: In-depth Module - Spheres of Life - Self Assignment BAK [T-ZAK-112657]

**Responsibility:** Dr. Christine Mielke
Christine Myglas

**Organisation:**
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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**Competence Certificate**
At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).
In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.
The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization.
In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

**Prerequisites**
Prerequisite for the ‘Oral Examination’ is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

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

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Annotation**
The content of the Basic Modul is helpful.
8.118 Course: In-depth Module - Technology & Responsibility - Self Assignment BAK [T-ZAK-112654]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**
- **Part of:** M-ZAK-106235 - Supplementary Studies on Culture and Society

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**Competence Certificate**
At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).
In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.
The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization.
In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

**Prerequisites**
Prerequisite for the ‘Oral Examination’ is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

**Self service assignment of supplementary studies**
This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Annotation**
The content of the Basic Modul is helpful.
8.119 Course: Industrial Aerodynamics [T-MACH-105375]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102818 - Major Field: Vehicle Technology

**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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<th>Industrial aerodynamics</th>
<th>2 SWS</th>
<th>/ Kröber, Frohnapfel</th>
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**Exams**

| WT 23/24 | 76-T-MACH-105375 | Industrial Aerodynamics | Kröber |
| ST 2024  | 76-T-MACH-105375 | Industrial Aerodynamics | Breitling |

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

**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 23/24, 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.

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**Organizational issues**

Blockvorlesung - Anmeldung erfolgt über das Sekretariat, max. Teilnehmerzahl sind 20 Studierende.

**Literature**

Vorlesungsskript

---

**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.**

---

**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.**

---

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.
8.120 Course: Information Engineering [T-MACH-102209]

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

**Part of:** M-MACH-102583 - Major Field: Information Management

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**Events**

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

**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 2024, 2 SWS, Language: German/English, Open in study portal

**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
8.121 Course: Information Processing in Sensor Networks [T-INFO-101466]

**Responsible:** Prof. Dr.-Ing. Uwe Hanebeck

**Organisation:** KIT Department of Informatics

**Part of:** M-MACH-102817 - Major Field: Information Technology

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**Exams**

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<tr>
<td>WT 23/24</td>
<td>Information Processing in Sensor Networks</td>
<td>Pfaff</td>
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</table>
8.122 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-102583 - Major Field: Information Management  
- M-MACH-102817 - Major Field: Information Technology

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<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**  
one
### 8.123 Course: Innovation and Project Management in Rail Vehicle Engineering [T-MACH-113068]

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

**Part of:** M-MACH-102638 - Major Field: Rail System Technology

<table>
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<td>2 SWS</td>
<td>Lecture / 🗣</td>
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<tr>
<td>ST 2024</td>
<td>Innovation and Project Management with Case Study “Innovative Rail Vehicle”</td>
<td>2 SWS</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**  
Presentation (duration approx. 20 minutes) and colloquium

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102583 - Major Field: Information Management
- M-MACH-102812 - Major Field: Powertrain Systems
- M-MACH-102815 - Major Field: Engineering Design
- M-MACH-102818 - Major Field: Vehicle Technology
- M-MACH-102820 - Major Field: Mechatronics

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**Events**

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<td>Innovation2Business – Innovation Strategy in the Industrial Corporate Practice</td>
<td>2 SWS</td>
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**Exams**

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<td>Lecture</td>
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</table>

**Competence Certificate**

Written exam based on the lecture handout and materials, duration 90 minutes

**Prerequisites**

none

**Recommendation**

None

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

### Innovation2Business – Innovation Strategy in the Industrial Corporate Practice

#### Lecture (V)

**V**

2 lecture blocks at the Bühl & Herzogenaurach locations with plant tours & fireside evenings + exam-preparatory Q&A.

Exam: written, limited to 40 seats (recommended for: Master's degree; mechanical engineering, industrial engineering, electrical engineering, computer science) → see module manual for details.

In this lecture series, use Schaeffler as an example to learn how global companies continuously transform themselves to grow sustainably and become maintain a leading position in the global market in the long term through business-oriented innovation.

Together we will go through the most important elements of the innovation and development process and learn about the successes and learnings based on vivid examples from practice.

Join the fireside evenings with the speakers to discuss the lecture content and beyond in a relaxed atmosphere.

The event is limited to 40 students and is free for you (meals, bus transfers & accommodations).

#### Organizational issues

Sprache: Unterlagen Englisch, Vortragssprache Deutsch

#### Literature

Vorlesungsumdruck
8.125 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-102583 - Major Field: Information Management
- M-MACH-102589 - Major Field: Production Systems
- M-MACH-102746 - Compulsory Elective Module

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

None

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

**Integrated Information Systems for engineers**

2121001, WS 23/24, 3 SWS, Language: German, [Open in study portal](#)

**Lecture / Practice (VÜ)**

**On-Site**

**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 modeling 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

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Bachelor's Program Mechanical Engineering (B.Sc.), Date: 23/02/2024
Module Handbook, valid from Summer Term 2024
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
8.126 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-102589 - Major Field: Production Systems

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**Events**

| ST 2024 | 2150660 | Integrated Production Planning in the Age of Industry 4.0 | 6 SWS | Lecture / Practice ( / ) | Lanza |

**Exams**

| WT 23/24 | 76-T-MACH-108849 | Integrated Production Planning in the Age of Industry 4.0 | Lanza |

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

**Competence Certificate**

Oral Exam (40 min)

**Prerequisites**

"T-MACH-109054 - Integrierte Produktionsplanung im Zeitalter von Industrie 4.0" as well as "T-MACH-102106 Integrierte Produktionsplanung" must not be commenced.

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

**Integrated Production Planning in the Age of Industry 4.0**

2150660, SS 2024, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ) On-Site
Content
Integrated Production Planning in the age of Industry 4.0 will be taught in the context of this engineering science lecture. In addition to a comprehensive introduction to Industry 4.0, the following topics will be addressed at the beginning of the lecture:

- Basics, history and temporal development of production
- Integrated production planning and integrated digital engineering
- Principles of integrated production systems and further development with Industry 4.0

Building on this, the phases of integrated production planning are taught in accordance with VDI Guideline 5200, whereby special features of parts production and assembly are dealt with in the context of case studies:

- Factory planning system
- Definition of objectives
- Data collection and analysis
- Concept planning (structural development, structural dimensioning and rough layout)
- Detailed planning (PPS, process simulation as a validation tool, planning of conveyor technology and storage systems for linking production and IT systems in the I4.0 factory)
- Preparation and monitoring of implementation
- Start-up and series support

The lecture contents are complemented by numerous current practical examples with a strong Industry 4.0 reference. Aspects of sustainability are anchored in all units and thus basic knowledge of sustainable production planning is taught. Within the exercises the lecture contents are deepened and applied to specific problems and tasks.

Learning Outcomes:
The students ...

- can discuss basic questions of production technology.
- are able to apply the methods of integrated production planning to new problems.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques for a specific problem.
- can apply the learned methods of integrated production planning to new problems.
- can use their knowledge targeted for efficient production technology.
- know the basic features of sustainable production planning and can apply underlying knowledge.

Workload:

MACH:
regular attendance: 63 hours
self-study: 177 hours

WING:
regular attendance: 63 hours
self-study: 207 hours

Organizational issues
Vorlesungstermine dienstags 14.00 Uhr und donnerstags 14.00 Uhr, Übungstermine donnerstags 15.45 Uhr. Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung.

Literature
Medien:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu) bereitgestellt.

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu).
8.127 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-102815 - Major Field: Engineering Design  
- M-MACH-102818 - Major Field: Vehicle Technology

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**Events**

| ST 2024  | 2150601 | Integrative Strategies in Production and Development of High Performance Cars | 2 SWS | Lecture / 🗣 | Schlichtenmayer |

| Exams   | 76-T-MACH-105188 | Integrative Strategies in Production and Development of High Performance Cars | Schlichtenmayer |

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

**Prerequisites**
none

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

**Integrative Strategies in Production and Development of High Performance Cars**
2150601, SS 2024, 2 SWS, Language: German, Open in study portal

On-Site
Content
The lecture deals with the technical and organizational aspects of integrated development and production of sports cars on the example of Porsche AG. The lecture begins with an introduction and discussion of social trends. The deepening of standardized development processes in the automotive practice and current development strategies follow. The management of complex development projects is a first focus of the lecture. The complex interlinkage between development, production and purchasing are a second focus. Methods of analysis of technological core competencies complement the lecture. The course is strongly oriented towards the practice and is provided with many current examples.

The main topics are:

- Introduction to social trends towards high performance cars
- Automotive Production Processes
- Integrative R&D strategies and holistic capacity management
- Management of complex projects
- Interlinkage between R&D, production and purchasing
- The modern role of manufacturing from a R&D perspective
- Global R&D and production
- Methods to identify core competencies

Learning Outcomes:
The students …

- are capable to specify the current technological and social challenges in automotive industry.
- are qualified to identify interlinkages between development processes and production systems.
- are able to explain challenges and solutions of global markets and global production of premium products.
- are able to explain modern methods to identify key competences of producing companies.

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

Literature
Medien:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
8.128 Course: Intellectual Property Rights and Strategies in Industrial Companies [T-MACH-105442]

Responsible: Prof. Dr.-Ing. Tobias Düser
Dipl.-Ing. Frank Zacharias

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102583 - Major Field: Information Management
M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102820 - Major Field: Mechatronics

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

Events

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<td>ST 2024</td>
<td>2147160</td>
<td>Patents and Patentstrategies in innovative companies</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
oral exam (ca. 20 min)

Prerequisites
none

Recommendation
None

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

Intellectual Property Rights and Strategies in Industrial Companies

2147161, WS 23/24, 2 SWS, Language: German, Open in study portal

Block (B)
On-Site
Content

Attendance at lectures (5 L): 24h

Personal preparation and follow-up of lecture and exercise: 5h

Preparation exam: 31h

The students understand and are able to describe the basics of intellectual property, particularly with regard to the filing and obtaining of property rights. They can name the criteria of project-integrated intellectual property management and strategic patenting in innovative companies. Students are also able to describe the key regulations of the law regarding employee invention and to illustrate the challenges of intellectual properties with reference to examples.

The lecture will describe the requirements to be fulfilled and how protection is obtained for patents, design rights and trademarks, with a particular focus on Germany, Europe and the EU. Active, project-integrated intellectual property management and the use of strategic patenting by technologically oriented companies will also be discussed. Furthermore, the significance of innovations and intellectual property for both business and industry will be demonstrated using practical examples, before going on to consider the international challenges posed by intellectual property and current trends in the sector. Within the context of licensing and infringement, insight will be provided as to the relevance of communication, professional negotiations and dispute resolution procedures, such as mediation for example. The final item on the agenda will cover those aspects of corporate law that are relevant to intellectual property.

Lecture overview:

1. Introduction to intellectual property
2. The profession of the patent attorney
3. Filing and obtaining intellectual property rights
4. Patent literature as a source of knowledge and information
5. The law regarding employee inventions
6. Active, project-integrated intellectual property management
7. Strategic patenting
8. The significance of intellectual property
9. International challenges and trends
10. Professional negotiations and dispute resolution procedures
11. Aspects of corporate law

Organizational issues

Weitere Informationen siehe IPEK-Homepage.

https://www.ipek.kit.edu/2976_2858.php

Patents and Patentstrategies in innovative companies

2147160, SS 2024, 2 SWS, Language: German, Open in study portal

On-Site
Content

Attendance at lectures (5 L): 24h

Personal preparation and follow-up of lecture and exercise: 5h

Preparation exam: 31h

The students understand and are able to describe the basics of intellectual property, particularly with regard to the filing and obtaining of property rights. They can name the criteria of project-integrated intellectual property management and strategic patenting in innovative companies. Students are also able to describe the key regulations of the law regarding employee invention and to illustrate the challenges of intellectual properties with reference to examples.

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Lecture overview:

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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
8.129 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-102746 - Compulsory Elective Module
M-MACH-102820 - Major Field: Mechatronics

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

Events

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Competence Certificate

Oral exam (Duration: 2h)

Prerequisites

none

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

Introduction into Mechatronics

2105011, WS 23/24, 3 SWS, Language: German, Open in study portal

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

Content

Content:

- Introduction
- Structure of mechatronic systems
- Mathematical treatment of mechatronic systems
- Sensors and actuators
- Measurements: acquisition and interpretation
- Modelling of mechatronic systems
- Control and feedback control systems
- Information processing

Learning objectives:

The student has knowledge about the specific challenge of interdisciplinary collaboration within the framework of mechatronics. He is able to explain the origin, necessity and methodic implementation of interdisciplinary collaboration, to name the main difficulties as well as the special features within the development of mechatronic products from the point of view of development methodic.

The student has fundamental knowledge of modeling mechanical, hydraulically and electrically part systems and about suitable optimization methods.

The student knows the difference in use of the term "system" in mechatronic and mechanical use.

Literature

8.130 Course: Introduction to Ceramics [T-MACH-100287]

**Responsible:** apl. Prof. Dr. Günter Schell

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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<td>Introduction to Ceramics</td>
<td>Schell, Bucharsky, Wagner</td>
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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 23/24, 3 SWS, Language: German, Open in study portal

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

**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
8.131 Course: Introduction to Computational Fluid Dynamics [T-MACH-110362]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102582 - Major Field: Continuum Mechanics  
M-MACH-102746 - Compulsory Elective Module

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Events

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<th>2 SWS</th>
<th>Lecture / 🧩</th>
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Exams

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<th>76-T-MACH-110362</th>
<th>Introduction to Computational Fluid Dynamics</th>
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</table>

Prerequisites

Passing the "Tutorial Introduction to Computational Fluid Dynamics" (T-MACH-111033) is prerequisite for taking part in the exam.

Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-111033 - Tutorial Introduction to Computational Fluid Dynamics must have been passed.

Annotation

Knowledge of the contents of the courses "Continuum Mechanics of Solid and Fluids" and "Mathematical Methods of Continuum Mechanics" as well as the corresponding tutorials is expected.

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

V Introduction to Computational Fluid Dynamics  
2154533, SS 2024, 2 SWS, Language: German, Open in study portal

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

Content

- Introduction and Motivation, Fundamental Equations and Dimensionless Numbers
- Turbulence and Modelling (DNS, LES, RANS);
- Numerical Solution of the Navier Stokes Equations: Discretization and Solution Approaches (FDM, FVM), boundary and initial conditions, stability, mistakes in numerics and modelling
- Set-up of a numerical simulation: pre- and postprocessing, validation, result evaluation, discussion of results
- Introduction to open-source toolbox OpenFOAM: set-up of simulation, generation of numerical grid with different tools, data evaluation within OpenFOAM and with python;
- Introduction to a research oriented toolbox for turbulent flows (DNS based o Incompact3d): set-up of simulation, statistical evaluation and analysis with MATLAB und python;
- visualisation of simulation results in ParaView

This course includes a lecture and a computer course.

Organizational issues

Die Kenntnis der Vorlesungsinhalte "Kontinuumsmechanik der Festkörper und Fluide" sowie "Mathematische Methoden der Kontinuumsmechanik" wird vorausgesetzt.

Literature

Wird in der Vorlesung bekannt gegeben.
8.132 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-102819 - Major Field: Materials Science and Engineering

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**Events**

| ST 2024 | 2194724 | Introduction to High Temperature Materials | 2 SWS | Lecture / 🗣 Gorr |

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

**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 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V) On-Site**

**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**
Anmeldung verbindlich bis zum 14.04.2023 unter bronislava.gorr@kit.edu

**Literature**
- J. Young, High temperature oxidation and corrosion of metals, Elsevier, 2008
- Skript in elektronischer Form verfügbar.
8.133 Course: Introduction to Multi-Body Dynamics [T-MACH-105209]

Responsible: Dr.-Ing. Ulrich Römer
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102746 - Compulsory Elective Module
- M-MACH-102812 - Major Field: Powertrain Systems
- M-MACH-102820 - Major Field: Mechatronics
- M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics

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Exams

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

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 to Multibody Dynamics

2162235, SS 2024, 3 SWS, Language: German, Open in study portal

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

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.
8.134 Course: Introduction to Nonlinear Vibrations [T-MACH-105439]

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

**Type:** Oral examination  
**Credits:** 7  
**Grading scale:** Grade to a third  
**Recurrence:** Each winter term  
**Version:** 1

**Events**

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<td>2162247</td>
<td>Introduction to Nonlinear Vibrations</td>
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<td>WT 23/24</td>
<td>2162248</td>
<td>Introduction into the nonlinear vibrations (Tutorial)</td>
<td>2 SWS</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

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

**Prerequisites**  
none

**Recommendation**  
Vibration theory, Mathematical Methods of Vibration Theory, Dynamic Stability

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

**Introduction to Nonlinear Vibrations**  
2162247, WS 23/24, 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 23/24, 2 SWS, Language: German, Open in study portal

Content
Exercises related to the lecture
8.135 Course: Introduction to Nuclear Energy [T-MACH-105525]

**Responsible:** Prof. Dr.-Ing. Xu Cheng

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology

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**Events**

| WT 23/24 | 2189903 | Introduction to Nuclear Energy | 2 SWS | Lecture / 📕 | Cheng |

**Exams**

| WT 23/24 | 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:**

**V** Introduction to Nuclear Energy

2189903, WS 23/24, 2 SWS, Language: German, Open in study portal

**Lecture (V)** Blended (On-Site/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.
8.136 Course: Introduction to Numerical Fluid Dynamics [T-MACH-105515]

**Responsible:** Dr. Balazs Pritz  
**Organisation:** KIT Department of Mechanical Engineering  
Institute of Thermal Turbomachinery  
**Part of:** M-MACH-102838 - Major Field: Energy Converting Engines

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**Events**

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**Prerequisites**

- none

**Competence Certificate**

- Certificate of participation

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

**Introduction to numerical fluid dynamics**

2157444, WS 23/24, 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
8 COURSES
Course: Introduction to the Finite Element Method [T-MACH-105320]

8.137 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-102582 - Major Field: Continuum Mechanics
M-MACH-102746 - Compulsory Elective Module

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Legend: 🖥 Online, ☐ Blended (On-Site/Online), ⬆ On-Site, ❌ Cancelled

Competence Certificate
written exam (90 min)
prerequisites: passing the corresponding "Tutorial to Introduction to the Finite element method" (T-MACH-110330)

Prerequisites
Passing the "Tutorial to Introduction to the Finite element method" (T-MACH-110330) is a prerequisite for taking part in the exam.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110330 - Tutorial Introduction to the Finite Element Method must have been passed.

Annotation
Knowledge of the contents of the courses "Continuum Mechanics of Solids and Fluids" and "Mathematical Methods of Continuum Mechanics" as well as the corresponding tutorials are expected

Due to capacity reasons it is possible that not all students of this course can be admitted to the computer tutorials. Students of the bachelor's degree program in mechanical engineering who have chosen the Major Field Continuum Mechanics (SP-Nr 13) will be admitted to the computer tutorials in any case.

If additional places are available in the computer tutorials for this course, these will be allocated according to the BSc average grade.

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

V Introduction to the Finite Element Method
2162282, SS 2024, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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
• Jung, M., Langer, U.: Methode der finiten Elemente für Ingenieure: Eine Einführung in die numerischen Grundlagen und Computersimulation, Teubner 2013
8.138 Course: IT-Fundamentals of Logistics [T-MACH-105187]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102583 - Major Field: Information Management
- M-MACH-102812 - Major Field: Powertrain Systems
- M-MACH-102817 - Major Field: Information Technology
- M-MACH-102820 - Major Field: Mechatronics
- M-MACH-102821 - Major Field: Technical Logistics

**Type**
- Oral examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each summer term

**Version**
- 4

**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
Lab Computer-Aided Methods for Measurement and Control [T-MACH-105341]

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

Part of: M-MACH-102817 - Major Field: Information Technology

**Type**  
Completed coursework

**Credits**  
4

**Grading scale**  
pass/fail

**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**

Colloquia

**Prerequisites**

none

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

Lab Computer-aided methods for measurement and control

2137306, WS 23/24, 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 this 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
Für Übungen sind Anleitungen auf der Institutshomepage erhältlich.

Instructions to the experiments are available on the institute's website.
8.140 Course: Laboratory Exercise in Energy Technology [T-MACH-105331]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer
Prof. Dr. Ulrich Maas
Dr.-Ing. Heinrich Wirbser

**Organisation:** KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology

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**Exams**

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<th>Title</th>
<th>Type</th>
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<tr>
<td>WT 23/24</td>
<td>76-T-MACH-105331</td>
<td>Laboratory Exercise in Energy Technology</td>
<td>Practical course / Online</td>
<td>Bauer, Maas, Wirbser, Bykov</td>
</tr>
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<td>ST 2024</td>
<td>76-T-MACH-105331</td>
<td>Laboratory Exercise in Energy Technology</td>
<td>Practical course / Online</td>
<td>Bauer, Maas, Wirbser</td>
</tr>
</tbody>
</table>

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

**Competence Certificate**
1 report, approx. 12 pages
Discussion of the documented results with the assistants

**Prerequisites**
none

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

**Laboratory Exercise in Energy Technology**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Type</th>
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<tr>
<td>2171487, WS 23/24, 3 SWS, Language: German/English</td>
<td>Practical course (P)</td>
<td>On-Site</td>
<td>Bauer, Maas, Wirbser</td>
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</tbody>
</table>

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
Content
Online registration within the first two weeks of the lecture period at: http://www.its.kit.edu

- Micro gas turbine
- Several test rigs for the investigation of heat transfer at thermally high loaded components
- Optimization of components of the internal air and oil system
- Characterization of spray nozzles
- Investigation of pollutant and noise emission as well as reliability and material deterioration
- Exhaust gas treatment
- Exhaust gas turbocharger
- Cooling Tower
- Heat pump
- Plant oil stove
- Heat capacity
- Wood combustion

regular attendance: 42h
self-study: 78h

Attending this course enables the students to:

- accomplish experimental and design related as well as theoretical tasks in a scientific background
- perform a correct evaluation of the obtained results
- adequately document and present their results in a scientific framework

1 report, approx. 12 pages
Discussion of the documented results with the assistants

Duration: 30 minutes

no tools or reference materials may be used

Organizational issues
Information zum Lehrlabor finden Sie auf der Instituts-homepage
8.141 Course: Laboratory Laser Materials Processing [T-MACH-102154]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

<table>
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**Events**

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<td>2183640</td>
<td>Laboratory &quot;Laser Materials Processing&quot;</td>
<td>3</td>
<td>Practical course / Online</td>
<td>Schneider, Pfleging</td>
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<td>ST 2024</td>
<td>2183640</td>
<td>Laboratory &quot;Laser Materials Processing&quot;</td>
<td>3</td>
<td>Practical course / Online</td>
<td>Schneider, Pfleging</td>
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**Exams**

<table>
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<th>Responsible</th>
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</thead>
<tbody>
<tr>
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<td>76-T-MACH-102154</td>
<td>Laboratory Laser Materials Processing</td>
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<tr>
<td>ST 2024</td>
<td>76-T-MACH-102154</td>
<td>Laboratory Laser Materials Processing</td>
<td>Schneider</td>
</tr>
</tbody>
</table>

**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, WS 23/24, 3 SWS, Language: German, Open in study portal

**Practical course (P)**

Blended (On-Site/Online)
Content
The laboratory compromises 8 half-day experiments, which address the following laser processing topics of metals, ceramics and polymers:
- safety aspects
- surface hardening and remelting
- melt and reactive cutting
- surface modification by dispersing or alloying
- welding
- surface texturing
- metrology

There are used CO2-, excimer-, Nd:YAG- and high power diode-laser sources within the laboratory.

The student
- can describe the influence of laser, material and process parameters and can choose suitable parameters for the most important methods of laser-based processing in automotive engineering.
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

The attendance to one of the courses Physical Basics of Laser Technology (2181612) or Laser Application in Automotive Engineering (2182642) is strongly recommended.

regular attendance: 34 hours
self-study: 86 hours

The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Organizational issues
Maximal 12 Teilnehmer/innen!
Aktuell sind alle Plätze vergeben! Registrierung für die Nachrückliste möglich per Email an johannes.schneider@kit.edu
Praktikum findet in Kleingruppen semesterbegleitend (dienstags bzw. mittwochs, halbtäglich) 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
Content
The laboratory compromises 8 half-day experiments, which address the following laser processing topics of metals, ceramics and polymers:

- safety aspects
- surface hardening and remelting
- melt and reactive cutting
- surface modification by dispersing or alloying
- welding
- surface texturing
- metrology

There are used CO2-, excimer-, Nd:YAG- and high power diode-laser sources within the laboratory.

The student

- can describe the influence of laser, material and process parameters and can choose suitable parameters for the most important methods of laser-based processing in automotive engineering.
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

The attendance to one of the courses Physical Basics of Laser Technology (2181612) or Laser Application in Automotive Engineering (2182642) is strongly recommended.

regular attendance: 34 hours
self-study: 86 hours

The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Organizational issues
Die Praktikumsplätze für das Sommersemester 2024 sind bereits ausgebucht!
Anmeldung per Email an johannes.schneider@kit.edu
Das Praktikum findet semesterbegleitend in Kleingruppen am IAM-ZM (CS) bzw. IAM-AWP (CN) statt!
Die Termine werden zu Beginn des Semesters bekannt gegeben.

Literature
R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer
8.142 Course: Laboratory Mechatronics [T-MACH-105370]

Responsible: Prof. Dr. Veit Hagenmeyer
Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102815 - Major Field: Engineering Design
M-MACH-102817 - Major Field: Information Technology
M-MACH-102820 - Major Field: Mechatronics

Type | Completed coursework | Credits | Grading scale | Recurrence | Version
--- | --- | --- | --- | --- | ---
 | | | pass/fail | Each winter term | 4

Events

<table>
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<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<td>2105014</td>
<td>Laboratory mechatronics</td>
<td>3 SWS</td>
<td>Practical course / Fidlin, Hagenmeyer, Böhland, Stiller, Chen, Orth, Immel</td>
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Exams

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<tr>
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<td>76-T-MACH-105370</td>
<td>Laboratory Mechatronics</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate

The laboratory course is offered exclusively as ungraded course work. The assessment consists of a group colloquium at the beginning of the individual specialization phases (Part 1). In addition, a robot control system for a pick-and-place task must be successfully implemented in the group phase (Part 2).

Prerequisites

None

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

Laboratory mechatronics

<table>
<thead>
<tr>
<th>Events</th>
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<th>Grading scale</th>
<th>Recurrence</th>
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</table>

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
8.143 Course: Laboratory Production Metrology [T-MACH-108878]

**Responsible:** Prof. Dr.-Ing. Gisela Lanza  
Dr. Florian Stamer

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102589 - Major Field: Production Systems  
M-MACH-102820 - Major Field: Mechatronics

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

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<th>2150550</th>
<th>Laboratory Production Metrology</th>
<th>3 SWS</th>
<th>Practical course / 🗣</th>
<th>Lanza, Stamer</th>
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</thead>
</table>

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 an 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:*

<table>
<thead>
<tr>
<th>V Laboratory Production Metrology 2150550, SS 2024, 3 SWS, Language: German, Open in study portal</th>
</tr>
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<tbody>
<tr>
<td>Practical course (P) On-Site</td>
</tr>
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</table>

Bachelor's Program Mechanical Engineering (B.Sc.), Date: 23/02/2024  
Module Handbook, valid from Summer Term 2024
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

For organizational reasons the number of participants for the course is limited. Hence a selection process will take place. Applications are made via the homepage of wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

Literature

Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/). Additional reference to literature will be provided, as well.
8.144 Course: Laser in Automotive Engineering [T-MACH-105164]

Responsible: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102818 - Major Field: Vehicle Technology
         M-MACH-102819 - Major Field: Materials Science and Engineering

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

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<td>2182642</td>
<td>Laser Material Processing</td>
<td>Lecture /</td>
<td>2 SWS</td>
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<td>Each summer term</td>
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<td>76-T-MACH-105164</td>
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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 Material Processing [T-MACH-112763], 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-112763 - Laser Material Processing 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:

V Laser Material Processing
2182642, SS 2024, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site
**Content**

Based on a short description of the physical basics of laser technology the lecture reviews the most important high power lasers and their various applications in automotive engineering. Furthermore the application of laser light in metrology and safety aspects will be addressed.

- physical basics of laser technology
- laser beam sources (Nd:YAG-, CO2-, high power diode-laser)
- beam properties, guiding and shaping
- basics of materials processing with lasers
- laser applications in material processing
- 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)

**Organizational issues**

Die Vorlesung ersetzt die bisherige Vorlesung "Lasereinsatz im Automobilbau" und wird jetzt auf Englisch angeboten!

The lecture replaces the previous lecture "Laser Application in Automotive Engineering" and is now offered in English!

**Literature**

P. Poprawe: Tailored Light 1, 2018, Springer  
R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer
8.145 Course: Laser Material Processing [T-MACH-112763]

**Responsible:** Dr.-Ing. Johannes Schneider  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102818 - Major Field: Vehicle Technology  
M-MACH-102819 - Major Field: Materials Science and Engineering

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

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<th>Version</th>
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<td>Grade to a third</td>
<td>Each summer term</td>
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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**  
oral examination (30 min)  
no tools or reference materials

**Prerequisites**  
It is not possible, to combine this brick with Laser in Automotive Engineering [T-MACH-105164], brick Physical Basics of Laser Technology [T-MACH-109084] and brick Physical Basics of Laser Technology [T-MACH-102102].

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

1. The course T-MACH-102102 - Physical Basics of Laser Technology must not have been started.
2. The course T-MACH-105164 - Laser in Automotive Engineering 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 Material Processing**  
2182642, SS 2024, 2 SWS, Language: English, [Open in study portal](#)  
[On-Site](#)
Content
Based on a short description of the physical basics of laser technology the lecture reviews the most important high power lasers and their various applications in automotive engineering. Furthermore the application of laser light in metrology and safety aspects will be addressed.

- physical basics of laser technology
- laser beam sources (Nd:YAG-, CO2-, high power diode-laser)
- beam properties, guiding and shaping
- basics of materials processing with lasers
- laser applications in material processing
- 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
Die Vorlesung ersetzt die bisherige Vorlesung "Lasereinsatz im Automobilbau" und wird jetzt auf Englisch angeboten!
The lecture replaces the previous lecture "Laser Application in Automotive Engineering" and is now offered in English!

Literature
P. Poprawe: Tailored Light 1, 2018, Springer
R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer
8.146 Course: Leadership and Conflict Management [T-MACH-105440]

**Responsible:** Hans Hatzl  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102815 - Major Field: Engineering Design

<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>Oral examination</td>
<td>4</td>
<td>Grade to a third</td>
<td>Each summer term</td>
<td>2</td>
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</table>

**Events**

| ST 2024 | 2110017 | Leadership and Conflict Management (in German) | 2 SWS | Lecture / 🗣 | Hatzl |

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

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

**Prerequisites**
It is not possible to combine this brick with brick Leadership and Conflict Management [T-MACH-111070].

**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 2024, 2 SWS, Language: German, Open in study portal |
| Lecture (V) On-Site |

**Content**
In this compact event, management and leadership techniques are taught which are among the key qualifications for management tasks. Furthermore, you will be prepared for management and leadership tasks.

The course consists of the following course contents:

1. Introduction to the topic  
   - Goal setting and goal achievement  
   - Management techniques in planning  
   - Communication and information  
   - Decision Theory  
   - Leadership and cooperation  
   - Self Management  
   - Conflict management and strategy  
   - Case studies

It passes:

- Obligatory attendance

recommendations:

- Knowledge of work and economic science is advantageous

**Literature**
Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.
8.147 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-102812 - Major Field: Powertrain Systems  
M-MACH-102815 - Major Field: Engineering Design

<table>
<thead>
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<th>Credits</th>
<th>Grading scale</th>
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<td>Each winter term</td>
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**Events**

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<td>Lecture / 🗣</td>
<td>2 SWS</td>
<td>Leadership and Product Development</td>
<td>Each winter term</td>
<td>Ploch</td>
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**Exams**

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<td>Leadership and Management Development</td>
<td>2 SWS</td>
<td>Each winter term</td>
<td>Ploch</td>
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</tbody>
</table>

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

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

**Prerequisites**  
It is not possible to combine this brick with brick Leadership and Management Development [T-MACH-112585].

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

### Leadership and Product Development

2145184, WS 23/24, 2 SWS, Language: German, Open in study portal

**Lecture (V)**  
On-Site

**Content**

Overview of leadership theories and their application  
Selected management instruments and their use in organizations  
Communication and leadership  
change management  
Management development and MD programmes  
Assessment centres and management audits  
Teamwork, team development and team roles  
Coaching as an instrument of modern leadership  
Intercultural competence and cross-cultural leadership  
Management and ethics, corporate governance  
Practical exercises and examples to deepen selected contents

**Organizational issues**

Vorlesungsanmeldung und Informationen zur Veranstaltung werden im ILIAS Kurs zur Verfügung gestellt.  
Weitere Information siehe IPEK-Homepage

**Literature**

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

**Responsible:** Prof. Dr.-Ing. Luise Kärger  
Dr.-Ing. Wilfried Liebig

**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102818 - Major Field: Vehicle Technology

<table>
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<td>2113110</td>
<td>Lightweight constructions with fiber-reinforced-polymers – theory and practice</td>
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<td>Kärger, Liebig</td>
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**Exams**

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<td>Lightweight constructions with fiber-reinforced-polymers – theory and practice</td>
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<td>Liebig, Kärger</td>
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</table>

**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**

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

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

Learning Objectives
Students will be able to name and explain lightweight design strategies. They are familiar with typical fiber and matrix materials and their function in fiber composite materials. They will be familiar with the operating principle of a sandwich composite with foam core and will be able to describe and justify typical deformation and stress curves. They can name characteristic mechanical parameters and manufacturing processes. For the numerical analysis of FRP components, the students know simple laminate theories, they can set up a finite element model in Abaqus, select suitable finite elements, evaluate the simulation results and derive conclusions for improving the load-bearing effect. Students know the main steps and boundary conditions for manual fabrication and mechanical testing of fiber composite sandwich structures and can apply them in practice. They learn to work independently in teams on an open task, to elaborate the necessary boundary conditions and parameters and to obtain additional information where necessary.
8.149 Course: Lightweight Engineering Design [T-MACH-105221]

Responsible: Prof. Dr.-Ing. Tobias Düser
Sascha Ott

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology

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<td>Lightweight Engineering Design</td>
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<td>Düser, Ott, Albers, Burkardt</td>
</tr>
</tbody>
</table>

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:

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
8.150 Course: Machine Dynamics [T-MACH-105210]

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

Part of:
- M-MACH-102746 - Compulsory Elective Module
- M-MACH-102812 - Major Field: Powertrain Systems
- M-MACH-102820 - Major Field: Mechatronics
- M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics
- M-MACH-104442 - Major Field: Vibration Theory

Type | Credits | Grading scale | Recurrence | Version 
--- | --- | --- | --- | --- 
Written examination | 5 | Grade to a third | Each summer term | 1

Events

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<th>Recurrence</th>
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Exams

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<th>Recurrence</th>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗤 On-Site, ✗ Cancelled

Competence Certificate
written exam, 180 min.

Prerequisites
none

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

**Machine Dynamics**
2161224, WS 23/24, 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

**Machine Dynamics**
2161224, SS 2024, 2 SWS, Language: German/English, [Open in study portal]

Lecture (V) [On-Site]

Content
1. Introduction
2. Machine as mechatronic system
3. Rigid rotors: equations of motion, transient and stationary motion, balancing
4. Flexible rotors: Laval rotor (equations of motion, transient and stationary behavior, critical speed, secondary effects), refined models
5. Slider-crank mechanisms: kinematics, equations of motion, mass and power balancing
Literature
Biezeno, Grammel: Technische Dynamik, 2. Aufl., 1953
Holzweißig, Dresig: Lehrbuch der Maschinendynamik, 1979
Dresig, Vulfson: Dynamik der Mechanismen, 1989

Machine Dynamics (Tutorial)
2161225, SS 2024, 1 SWS, Language: English, Open in study portal

Content
Exercises related to the lecture
8.151 Course: Machine Dynamics II [T-MACH-105224]

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

Part of:
M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102820 - Major Field: Mechatronics
M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104442 - Major Field: Vibration Theory

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

Competence Certificate
oral exam, 30 min.

Prerequisites
none

Recommendation
Machine Dynamics

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

V Machine Dynamics II
2162220, WS 23/24, 2 SWS, Language: English, Open in study portal

Content
hydrodynamic bearings
• rotating shafts in hydrodynamic bearings
• belt drives
• vibration of turbine blades

Organizational issues
Die Vorlesung wird ausschließlich online angeboten.

Literature

V Machine Dynamics II
2162220, SS 2024, 2 SWS, Language: German/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
### 8.152 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-102589 - Major Field: Production Systems  
- M-MACH-102815 - Major Field: Engineering Design

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**Events**

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**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:**

<table>
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<th>Event Code</th>
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<td>Machine Tools and High-Precision Manufacturing Systems</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗿 On-Site, ✗ Cancelled
Content
The lecture gives an overview of the construction, use and application of machine tools and high-precision manufacturing systems. In the course of the lecture a well-founded and practice-oriented knowledge for the selection, design and evaluation of machine tools and high-precision manufacturing systems is conveyed. First, the main components of the systems are systematically explained and their design principles as well as the integral system design are discussed. Subsequently, the use and application of machine tools and high-precision manufacturing systems will be demonstrated using typical machine examples. Based on examples from current research and industrial applications, the latest developments are discussed, especially concerning the implementation of Industry 4.0 and artificial intelligence. Guest lectures from industry round off the lecture with insights into practice.

The individual topics are:
- Structural components of dynamic manufacturing Systems
- Feed axes: High-precision positioning
- Spindles of cutting machine Tools
- Peripheral Equipment
- Machine control unit
- Metrological Evaluation
- Maintenance strategies and condition Monitoring
- Process Monitoring
- Development process for machine tools and high-precision manufacturing Systems
- Machine examples

Learning Outcomes:
The students …
- are able to assess the use and application of machine tools and high-precision manufacturing systems and to differentiate between them in terms of their characteristics and design.
- can describe and discuss the essential elements of machine tools and high-precision manufacturing systems (frame, main spindle, feed axes, peripheral equipment, control unit).
- are able to select and dimension the essential components of machine tools and high-precision manufacturing systems.
- are capable of selecting and evaluating machine tools and high-precision manufacturing systems according to technical and economic criteria.

Workload:
MACH:
regular attendance: 63 hours
self-study: 177 hours

WING/TVWL:
regular attendance: 63 hours
self-study: 207 hours

Organizational issues
Vorlesungstermine montags und mittwochs, Übungstermine donnerstags.
Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung.

Lectures on Mondays and Wednesdays, tutorial on Thursdays. The tutorial dates will announced in the first lecture.

Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (https://www.karlsruher-forschungsfabrik.de) unterstützt.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (https://www.karlsruher-forschungsfabrik.de/en.html) to deepen the acquired knowledge.

Literature
Medien:
Skript zur Veranstaltung wird über Ilias (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
8.153 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-102817 - Major Field: Information Technology

<table>
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**Events**

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**Exams**

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**Competence Certificate**

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

**Prerequisites**

None

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

**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.
8.154 Course: Machines and Processes [T-MACH-105208]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
Dr.-Ing. Heiko Kubach  
Prof. Dr. Ulrich Maas  
Dr. Balazs Pritz

**Organisation:** KIT Department of Mechanical Engineering

Institute of Thermal Turbomachinery

**Part of:** M-MACH-102566 - Machines and Processes

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**Events**

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**Exams**

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**Competence Certificate**
written exam (duration: 120 min)

**Prerequisites**
Taking part at the exam is possible only when lab course has been successfully completed

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

1. The course T-MACH-105232 - Machines and Processes, Prerequisite must have been passed.

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

**Machines and Processes**
2185000, WS 23/24, 4 SWS, Language: German, Open in study portal  
Lecture / Practice (VÜ)  
On-Site
Content

• Introduction to power engineering
• Radial and axial turbines
• Pumps
• Compressors
• Blowers
• Wind turbines
• Fuel cells
• Energy storage
• E-motors
• Heat pumps
• Combined heat and power
• Diesel engines
• Gasoline engines
• Hydrogen engines
8.155 Course: Machines and Processes, Prerequisite [T-MACH-105232]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer
Dr.-Ing. Heiko Kubach
Prof. Dr. Ulrich Maas
Dr. Balazs Pritz

**Organisation:** KIT Department of Mechanical Engineering

Institute of Thermal Turbomachinery

Part of: M-MACH-102566 - Machines and Processes

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**Type**
- Completed coursework

**Credits**
- 0

**Grading scale**
- pass/fail

**Recurrence**
- Each term

**Version**
- 1

**Legend:**
- 🖥 Online
- 🍭 Blended (On-Site/Online)
- 🗣 On-Site
- ❌ Cancelled

**Competence Certificate**
- successful completed training course

**Prerequisites**
- none

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

**Machines and Processes**
- 2187000, WS 23/24, 1 SWS, Open in study portal
- Practical course (P) On-Site

**Content**
- Lab Course Experiment

**Machines and Processes (Lab Course)**
- 2187000, SS 2024, 1 SWS, Language: German, Open in study portal
- Practical course (P) On-Site
**Content**

successful lab course and written exam (2 h)

Taking part at the exam is possible only when lab course has been successfully completed

Lab course and lecture take place in summer and winter semester.

In the SS the lecture is held in English. The lab course is always bilingual.

**Media:**

slides to download

Documentation of the labcourse

basics of thermodynamics

thermal fluid machines

- steam turbines
- gas turbines
- combined-cycle plants
- turbines and compressors
- aircraft engines

hydraulic fluid machines

- operating performance
- characterization
- control
- cavitation
- wind turbines, propellers

internal combustion engines

- characteristic parameters
- engine parts
- kinematics
- engine processes
- emissions

regular attendance: 48 h, self-study: 160 h

The students can name and describe basic energy conversion processes and energy converting machines. They can explain the application of these energy conversion processes in various machines. They can analyze and evaluate the processes and machines in terms of functionality and efficiency and they are able to solve basic technical problems in terms of operating the machines.
8.156 Course: Manufacturing Technology [T-MACH-102105]

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

Part of: M-MACH-102589 - Major Field: Production Systems
         M-MACH-102815 - Major Field: Engineering Design

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Exams

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

Competence Certificate
Written Exam (180 min)

Prerequisites
none

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

Manufacturing Technology
2149657, WS 23/24, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
Blended (On-Site/Online)
Content
The objective of the lecture is to look at manufacturing technology within the wider context of production engineering, to provide an overview of the different manufacturing processes and to impart detailed process knowledge of the common processes. The lecture covers the basic principles of manufacturing technology and deals with the manufacturing processes according to their classification into main groups regarding technical and economic aspects. The lecture is completed with topics such as process chains in manufacturing.

The following topics will be covered:

- Quality control
- Primary processing (casting, plastics engineering, sintering, additive manufacturing processes)
- Forming (sheet-metal forming, massive forming, plastics engineering)
- Cutting (machining with geometrically defined and geometrically undefined cutting edges, separating, abrading)
- Joining
- Coating
- Heat treatment and surface treatment
- Process chains in manufacturing

This lecture provides an excursion to an industry company.

Learning Outcomes:
The students ...

- are capable to specify the different manufacturing processes and to explain their functions.
- are able to classify the manufacturing processes by their general structure and functionality according to the specific main groups.
- have the ability to perform a process selection based on their specific characteristics.
- are enabled to identify correlations between different processes and to select a process regarding possible applications.
- are qualified to evaluate different processes regarding specific applications based on technical and economic aspects.
- are experienced to classify manufacturing processes in a process chain and to evaluate their specific influence on surface integrity of workpieces regarding the entire process chain.

Workload:
regular attendance: 63 hours
self-study: 177 hours

Organizational issues
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/).
8.157 Course: Materials Characterization [T-MACH-107684]

**Responsible:** Dr.-Ing. Jens Gibmeier  
Prof. Dr. Reinhard Schneider

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

**Competence Certificate**

Oral exam, about 25 minutes

**Prerequisites**

Successful participation in Übungen zu Werkstoffanalytik is the condition for the admittance to the oral exam in Werkstoffanalytik.

- T-MACH-110945 – Exercises for Materials Characterization has not been started.
- T-MACH-110946 – Materials Characterization has not been started.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-107685 - Exercises for Materials Characterization must have been passed.

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

**Materials Characterization**  
2174586, SS 2024, 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.

**Literature**

Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.
# 8.158 Course: Materials of Lightweight Construction [T-MACH-105211]

**Responsible:** Dr.-Ing. Wilfried Liebig  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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**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 2024, 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
Litetraturhinweise, Unterlagen und Teilmanuskript in der Vorlesung
8.159 Course: Materials Recycling and Sustainability [T-MACH-110937]

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

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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**Events**

| ST 2024 | 2173520 | Materials Recycling and Sustainability | 2 SWS | Lecture / 🗣 | Liebig |

**Exams**

| WT 23/24 | 76-T-MACH-110937 | Materials Recycling and Sustainability | Liebig |

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

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

**Prerequisites**
none

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

**Materials Recycling and Sustainability**
2173520, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
On-Site

**Content**
The lecture series is organised in two main topics: On the one hand, fundamentals of sustainability are explained and it is shown how to tread more sustainable paths in materials science and mechanical engineering. On the other hand, separation and recycling processes for all common classes of materials are presented and discussed. It is shown how recycling fosters a holistic and sustainable perspective on material processing and use.

1. legal bases and historical background
2. climate change, ecology and material flows
3. sustainability in general
4. product responsibility, recyclable design and planned obsolescence
5. general and legal bases of recycling
6. material separation, sorting and processing
7. recycling of metals
8. recycling of polymers and composites
9. recycling of everyday materials
10. alternative materials and alternative design concepts
11. materials for renewable energy sources

**Literature**
Skript wird in der Vorlesung ausgegeben
8.160 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-102819 - Major Field: Materials Science and Engineering

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**Exams**

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**Competence Certificate**

Oral exam, about 35 minutes

**Prerequisites**

T-MACH-110818 - Plasticity of Metals and Intermetallics has not been started

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

**Materials Science and Engineering III**

Materials Science and Engineering III  
2173553, WS 23/24, 4 SWS, Language: German, Open in study portal

**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  
### 8.161 Course: Materials Science I & II [T-MACH-105145]

**Responsible:** Dr.-Ing. Jens Gibmeier  
Prof. Dr.-Ing. Martin Heilmaier  
Prof. Dr. Astrid Pundt

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102562 - Materials Science

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<td>Heilmaier, Kauffmann</td>
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<td>Gibmeier</td>
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<td>ST 2024</td>
<td>3174026</td>
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<td>Practice</td>
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**Exams**

<table>
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<tr>
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<th>Code</th>
<th>Description</th>
<th>Type</th>
<th>Credits</th>
<th>Grading</th>
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<tbody>
<tr>
<td>WT 23/24</td>
<td>76-T-MACH-105145</td>
<td>Materials Science I, II</td>
<td>Oral exam</td>
<td>11</td>
<td>Grade to a third</td>
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<td>WT 23/24</td>
<td>76-T-MACH-105145-English</td>
<td>Materials Science I &amp; II</td>
<td>Oral exam</td>
<td>11</td>
<td>Grade to a third</td>
</tr>
</tbody>
</table>

**Legends:** ☑ Online, ☑ Blended (On-Site/Online), ☑ On-Site, x Cancelled

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**Competence Certificate**

oral exam, about 25 minutes

**Prerequisites**

Lab course must be finished successfully prior to the registration for the oral exam.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-105146 - Materials Science Lab Course must have been passed.

**Annotation**

The workload for the lecture Materials Science I & II is 165 h per semester and consists of the presence during the lectures (WS: 4 SWS, SS: 2SWS) and the exercises (1 SWS per WS and 1 SWS per SS) as well as preparation and rework time at home.

*Below you will find excerpts from events related to this course:*
Content
Atomic structure and atomic bonds
Structures of crystalline solids
Defects in crystalline solids
Structure of amorphous and semi-crystalline solids
Alloys
Transport and transformation phenomena in the solid state
Microscopy methods
Characterization by means of X-rays, Neutrons and Electrons
Nondestructive testing of materials
Mechanical testing of materials

learning objectives:
The students are able to describe the relationship between atomic structure, microscopical observations, and properties of solid materials.
The students can describe the typical property profiles and can name applications for the most important engineering materials.
The students are able to describe standard materials characterization methods and can explain the evaluation of these methods. They can judge materials on base of the data obtained by these methods.

requirements:
None, Recommendations: None.

workload:
regular attendance: 53 hours
self-study: 157 hours

Literature
Vorlesungsskript; Videos, Übungsaufgabenblätter.
Shackelford, J.F., Werkstofftechnologie für Ingenieure, Verlag Pearson Studium, 2005
Skolaut, W., Maschinenbau (Ein Lehrbuch für das ganze Bachelor-Studium), Springer, Heidelberg 2014
Gottstein, G., Physikalische Grundlagen der Materialkunde, 3 Aufl., Springer Verlag, Berlin, 2007

Exercises in Materials Science and Engineering I for mach, phys

Content
Example exercises

learning objectives:
The students can apply the knowledge gained through the lecture as well as self-studies and transfer this knowledge to problems given.
They can carry out calculations independently dealing with different subjects of materials science. Therefore, they are able to decide which formulas allow the calculation based on the question given.
They are able to discuss aspects of materials science both quantitatively and qualitatively and can present these results orally.

requirements:
Lecture Materials Science and Engineering I

workload:
Regular attendance: 21 h, self studies: 21 h
Materials Science and Engineering I (Lecture)
3173008, WS 23/24, 4 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

Ferrous materials
Non-ferrous metals and alloys
Engineering ceramics
Glasses
Polymers
Composites

learning objectives:
The students are able to describe the relationship between atomic structure, microscopical observations, and properties of solid materials.

The students can name representative materials for different material classes and can describe the differences.

The students are able to describe the basic mechanisms of hardening for ferrous and non-ferrous materials and reflect these mechanisms using phase and TTT diagrams.

The students can interpret given phase, TTT or other diagrams relevant for materials science, gather information from them and can correlate them regarding the microstructure evolution.

The students can describe the phenomena correlated with materials science in polymers, metals and ceramics and depict differences.

The students know about standard materials characterization methods and are able to assess materials on base of the data obtained by these methods.

requirements:
Materials Science and Engineering I

workload:
regular attendance: 42 hours
self-study: 108 hours

examination:
Combined with 'Materials Science and Engineering I'; oral; about 30 minutes

The successful participation in the lab course is obligatory for the admission to the examination.

Materials Science and Engineering I (Tutorial)
3173009, WS 23/24, 1 SWS, Language: English, Open in study portal

Practice (Ü)
On-Site
**Content**

Exemplary calculations

**learning objectives:**

The students can apply the knowledge gained through the lecture as well as self-studies and transfer this knowledge to problems given. They can carry out calculations independently dealing with different subjects of materials science. Therefore, they are able to decide which formulas allow the calculation based on the question given. They are able to discuss aspects of materials science both quantitatively and qualitatively and can present these results orally.

**requirements:**

Lecture Materials Science and Engineering II

**workload:**

**Literature**

see lecture notes

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**Courses**

Course: Materials Science I & II [T-MACH-105145]

Bachelor's Program Mechanical Engineering (B.Sc.), Date: 23/02/2024

Module Handbook, valid from Summer Term 2024

---

**Content**

**Topics:**

Ferrous materials

Non-ferrous metals and alloys

Engineering ceramics

Glasses

Polymers

Composites

**Learning Objectives:**

The students are able to describe the relationship between atomic structure, microscopical observations, and properties of solid materials.

The students can name representative materials for different material classes and can describe the differences.

The students are able to describe the basic mechanisms of hardening for ferrous and non-ferrous materials and reflect these mechanisms using phase and TTT diagrams.

The students can interpret given phase, TTT or other diagrams relevant for materials science, gather information from them and can correlate them regarding the microstructure evolution.

The students can describe the phenomena correlated with materials science in polymers, metals and ceramics and depict differences.

The students know about standard materials characterization methods and are able to assess materials on base of the data obtained by these methods.

**Requirements:**

Materials Science and Engineering I

**Workload:**

regular attendance: 42 hours

self-study: 108 hours

**Examination:**

Combined with ‘Materials Science and Engineering I’; oral; about 30 minutes

The successful participation in the lab course is obligatory for the admission to the examination.

**Organizational issues**

Weitere Informationen zu dieser Veranstaltung finden Sie hier: https://www.iam.kit.edu/wk/lehre.php
**Exercises in Materials Science and Engineering II for mach, phys**  
2174563, SS 2024, 1 SWS, Language: German, Open in study portal

**Content**

**Learning Objectives:**

The students can apply the knowledge gained through the lecture as well as self-studies and transfer this knowledge to problems given.

They can carry out calculations independently dealing with different subjects of materials science. Therefore, they are able to decide which formulas allow the calculation based on the question given.

They are able to discuss aspects of materials science both quantitatively and qualitatively and can present these results orally.

**Requirements:**

Lecture on Materials Science and Engineering II

**Organizational issues**

Weitere Informationen finden Sie hier: https://www.iam.kit.edu/wk/lehre.php

**Literature**

Vorlesungsskript, Vorlesungsvideos, Übungsbögen, Übungsvideos

**Weiterführende Informationen gibt es hier:**

  https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC117341509
  http://dx.doi.org/10.1007/978-3-658-13795-3 (frei im KIT-Netz erhältlich)
  http://dx.doi.org/10.1007/978-3-642-36603-1 (frei im KIT-Netz erhältlich)
  https://www.ifw-dresden.de/de/ifw-institutes/km/lectures/vorlesungsskript-physikalische-werkstoffeigenschaften (frei zugänglich)
Content

Ferrous materials
Non-ferrous metals and alloys
Engineering ceramics
Glasses
Polymers
Composites

learning objectives:
The students are able to describe the relationship between atomic structure, microscopical observations, and properties of solid materials.

The students can name representative materials for different material classes and can describe the differences.

The students are able to describe the basic mechanisms of hardening for ferrous and non-ferrous materials and reflect these mechanisms using phase and TTT diagrams.

The students can interpret given phase, TTT or other diagrams relevant for materials science, gather information from them and can correlate them regarding the microstructure evolution.

The students can describe the phenomena correlated with materials science in polymers, metals and ceramics and depict differences.

The students know about standard materials characterization methods and are able to asses materials on base of the data obtained by these methods.

requirements:
Materials Science and Engineering I

workload:
regular attendance: 42 hours
self-study: 108 hours

examination:
Combined with 'Materials Science and Engineering I'; oral; about 30 minutes

The successful participation in the lab course is obligatory for the admission to the examination.

Literature
Vorlesungsskript; Übungsaufgabenblätter;

Shackelford, J.F.
Werkstofftechnologie für Ingenieure
Verlag Pearson Studium, 2005

Materials Science and Engineering II (Tutorials)
3174026, SS 2024, 1 SWS, Language: English, Open in study portal

Practice (Ü)
On-Site

Content
Exemplary calculations

learning objectives:
The students can apply the knowledge gained through the lecture as well as self-studies and transfer this knowledge to problems given.

They can carry out calculations independantly dealing with different subjects of materials science. Therefore, they are able to decide which formulas allow the calculation based on the question given.

They are able to discuss aspects of materials science both quantitatively and qualitatively and can present these results orally.

requirements:
Lecture Materials Science and Engineering II

workload:

Literature
see lecture notes
**8.162 Course: Materials Science Lab Course [T-MACH-105146]**

**Responsibility:** Dr.-Ing. Jens Gibmeier  
Prof. Dr.-Ing. Martin Heilmaier  
Prof. Dr. Astrid Pundt

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102562 - Materials Science

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<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<tr>
<td>Completed coursework (practical)</td>
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<td>pass/fail</td>
<td>Each summer term</td>
<td>1</td>
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</table>

**Events**

| ST 2024   | 2174597 | Experimental Lab Course in Material Science | 3 SWS | Practical course / On-Site | Wagner, Heilmaier, Pundt, Dietrich, Guth |
| ST 2024   | 3174016 | Materials Science and Engineering Lab Course | 3 SWS | Practical course / On-Site | Gibmeier, Heilmaier, Pundt |

**Coment Certificate**

Oral colloquium at the beginning of each topic; certificate of successful attendance.

**Prerequisites**

none

**Annotation**

The workload for the lab course Materials Science is 90 h in total and consists of the presence during the 10 experiments (one week half-time, 4 hours per day) as well as preparation and rework time at home.

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

**Experimental Lab Course in Material Science**  
2174597, SS 2024, 3 SWS, Language: German, Open in study portal

**Practical course (P)**  
On-Site

**Content**

Performing and evaluating of laboratory experiments in the following topics:

- Mechanical testing of materials
- Nonmetallic materials
- Microstructure and properties
- Cyclic loading / fatigue
- Influence of manufacturing technique on materials

**Learning objectives:**

The students are able to describe the relationship between atomic structure, microscopical observations, and properties of solid materials.

The students can name standard materials characterization methods and can describe the execution of the tests as well as the evaluation of the results. The students are able to asses materials on base of the data obtained by these methods.

The students are capable to select appropriate experiments to clarify problems regarding the materials behaviour. They can describe the experimental procedures and can carry out experiments. They can derive material properties from data gained in experiments. They can interpret these properties regarding microstructure-property-relations.

**Requirements:**

- Materials Science and Engineering I & II

**Workload:**

- Regular attendance: 22 hours
- Self-study: 68 hours

**Organizational issues**

Blockveranstaltung. Infos durch ILIAS und in der VL WK II. Anmeldung erforderlich.
Materials Science and Engineering Lab Course
3174016, SS 2024, 3 SWS, Language: English, Open in study portal

Content
Performing and evaluating of laboratory experiments in the following topics:

- Mechanical testing of materials
- Nonmetallic materials
- Microstructure and properties
- Cyclic loading / fatigue
- Influence of manufacturing technique on materials

Learning objectives:
The students are able to describe the relationship between atomic structure, microscopical observations, and properties of solid materials.

The students can name standard materials characterization methods and can describe the execution of the tests as well as the evaluation of the results. The students are able to assess materials on base of the data obtained by these methods.

The students are capable to select appropriate experiments to clarify problems regarding the materials behaviour. They can describe the experimental procedures and can carry out experiments. They can derive material properties from data gained in experiments. They can interpret these properties regarding microstructure-property-relations.

Requirements:
Materials Science and Engineering I & II

Workload:
regular attendance: 22 hours
self-study: 68 hours

Organizational issues
Registration required. Note announcements (MSE lecture and ILIAS)

Literature
Praktikumsskriptum

Shackelford, J.F.
Werkstofftechnologie für Ingenieure
Verlag Pearson Studium, 2005
8.163 Course: Mathematical Methods in Continuum Mechanics [T-MACH-110836]

Responsible: Prof. Dr.-Ing. Thomas Böhlke

Organisation:
Part of: M-MACH-102582 - Major Field: Continuum Mechanics

<table>
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<th>Type</th>
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<td>Each winter term</td>
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Events

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<tr>
<td>WT 23/24 2161254</td>
<td>Mathematical Methods in Continuum Mechanics 2 SWS</td>
<td>Lecture / Böhlke</td>
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Exams

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<tr>
<td>WT 23/24 76-T-MACH-110836</td>
<td>Mathematical Methods in Continuum Mechanics</td>
<td>Böhlke</td>
</tr>
</tbody>
</table>

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

Competence Certificate
written exam (90 min). Additives as announced.
There are no prerequisites within the Major Field 13 (Continuum Mechanics)

Annotation
This brick can only be chosen within Major Field 13 of Bachelor studies Mechanical Engineering. There are no prerequisites for the exam.

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

Mathematical Methods in Continuum Mechanics
2161254, WS 23/24, 2 SWS, Language: German, Open in study portal

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
8 COURSES
Course: Mathematical Methods in Continuum Mechanics [T-MACH-110375]

8.164 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-102746 - Compulsory Elective Module

<table>
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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>Code</th>
<th>Lecture</th>
<th>Location</th>
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<tbody>
<tr>
<td>WT 23/24</td>
<td>2161254</td>
<td>Mathematical Methods in Continuum Mechanics</td>
<td>Böhlke</td>
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Exams

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<th>Exams</th>
<th>Code</th>
<th>Lecture</th>
<th>Location</th>
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<tbody>
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<td>WT 23/24</td>
<td>76-T-MACH-110375</td>
<td>Mathematical Methods in Continuum Mechanics</td>
<td>Böhlke</td>
</tr>
</tbody>
</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 23/24, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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
8.165 Course: Mathematical Methods in Dynamics [T-MACH-105293]

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

Part of: M-MACH-102746 - Compulsory Elective Module
M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics

<table>
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Events

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<td>WT 23/24</td>
<td>Mathematical Methods in Dynamics</td>
<td>2 SWS</td>
<td>Lecture / 🧩</td>
<td>Profpe</td>
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<tr>
<td>ST 2024</td>
<td>Mathematical Methods in Dynamics</td>
<td>2 SWS</td>
<td>Lecture / ☣</td>
<td>Profpe</td>
</tr>
<tr>
<td>WT 23/24</td>
<td>Übungen zu Mathematische Methoden der Dynamik</td>
<td>1 SWS</td>
<td>Practice / 🗣</td>
<td>Profpe, Bitner</td>
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Exams

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<tr>
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<th>Course Title</th>
<th>Type</th>
<th>Organisers</th>
</tr>
</thead>
<tbody>
<tr>
<td>76-T-MACH-105293</td>
<td>Mathematical Methods in Dynamics</td>
<td>Lecture (V)</td>
<td>Profpe</td>
</tr>
</tbody>
</table>

Competence Certificate

written examination, 180 min.

Prerequisites

none

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

Mathematical Methods in Dynamics
2161206, WS 23/24, 2 SWS, Language: German, Open in study portal

Content

Dynamics of continua:
- Concept of continuum, geometry of continua, kinematics and kinetics of continua

Dynamics of rigid bodies:
- Kinematics and kinetics of rigid bodies

Variational principles:
- Principle of virtual work, variational calculations, Principle of Hamilton

Approximate solution methods:
- Methods of weighted residuals, method of Ritz

Applications
Literature
Vorlesungsskript (erhältlich im Internet)

J.E. Marsden, T.J.R. Hughes: Mathematical foundations of elasticity, New York, Dover, 1994

P. Haupt: Continuum mechanics and theory of materials, Berlin, Heidelberg, 2000

M. Riemer: Technische Kontinuumsmechanik, Mannheim, 1993


Übungen zu Mathematische Methoden der Dynamik
2161207, WS 23/24, 1 SWS, Language: German, Open in study portal

Content
Exercises related to the lecture

Mathematical Methods in Dynamics
2161206, SS 2024, 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

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


8.166 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-102746 - Compulsory Elective Module

<table>
<thead>
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<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<tbody>
<tr>
<td>Written examination</td>
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<td>Grade to a third</td>
<td>Each summer term</td>
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**Events**

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<th>Lecture / Practice</th>
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<tr>
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<td>4 SWS</td>
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<td>Lecture / Practice</td>
<td>Gatti, Frohnapfel</td>
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<tr>
<td>ST 2024 2154540</td>
<td>4 SWS</td>
<td>Mathematical Methods in Fluid Mechanics</td>
<td>Lecture / Practice</td>
<td>Gatti, Frohnapfel</td>
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**Exams**

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<th>Credits</th>
<th>Type</th>
<th>Lecture / Practice</th>
<th>Organisers</th>
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<tr>
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<td>Mathematical Methods in Fluid Mechanics</td>
<td>Lecture / Practice</td>
<td>Frohnapfel</td>
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<tr>
<td>WT 23/24 76-T-MACH-105295 (engl.)</td>
<td>4 SWS</td>
<td>Mathematical Methods in Fluid Mechanics</td>
<td>Lecture / Practice</td>
<td>Frohnapfel, Gatti</td>
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<tr>
<td>ST 2024 76-T-MACH-105295</td>
<td>4 SWS</td>
<td>Mathematical Methods in Fluid Mechanics</td>
<td>Lecture / Practice</td>
<td>Frohnapfel, Gatti</td>
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<tr>
<td>ST 2024 76-T-MACH-105295 (engl.)</td>
<td>4 SWS</td>
<td>Mathematical Methods in Fluid Mechanics</td>
<td>Lecture / Practice</td>
<td>Gatti, Frohnapfel</td>
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</tbody>
</table>

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

**Competence Certificate**
written examination - 3 hours

**Prerequisites**
none

**Recommendation**
Basic Knowledge about Fluid Mechanics

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

**Mathematical Methods in Fluid Mechanics**
2154432, SS 2024, 4 SWS, Language: German/English, Open in study portal

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

**Content**
The students can simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical methods in fluid mechanics effectively in order to solve the resulting governing equations analytically, if possible, or to enable simpler numerical solution of the problem. The students can describe the limits of applicability of the assumptions made to model the flow behavior.

The lecture will cover a selection of the following topics:

- Creeping flows (Stokes flow)
- Lubrication theory
- Potential flow theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows

**Organizational issues**

Bachelor's Program Mechanical Engineering (B.Sc.), Date: 23/02/2024
Module Handbook, valid from Summer Term 2024
Mathematical Methods in Fluid Mechanics

2154540, SS 2024, 4 SWS, Language: English, Open in study portal

Contents

The students can simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical methods in fluid mechanics effectively in order to solve the resulting governing equations analytically, if possible, or to enable simpler numerical solution of the problem. The students can describe the limits of applicability of the assumptions made to model the flow behavior.

The lecture will cover a selection of the following topics:

- Creeping flows (Stokes flow)
- Lubrication theory
- Potential flow theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows

Literature

8.167 Course: Mathematical Methods of Vibration Theory [T-MACH-105294]

Responsibility: Prof. Dr.-Ing. Alexander Fidlin
Dr.-Ing. Ulrich Römer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102746 - Compulsory Elective Module
M-MACH-102820 - Major Field: Mechatronics
M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104442 - Major Field: Vibration Theory

<table>
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<th>Recurrence</th>
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Events

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<td>2 SWS</td>
<td>Lecture / X</td>
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Exams

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

Competence Certificate
written examination, 180 min.

Prerequisites
none

Recommendation
Engineering Mechanics III/IV

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

Mathematical methods of vibration theory

<table>
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Content
Linear, time-invariant, ordinary single differential equations: homogeneous solution; harmonic, periodic and non-periodic excitations; Duhamel’s integral; Fourier and Laplace transform; introduction into the theory of distributions; Systems of ordinary differential equations: matrix notation, eigenvalue theory, fundamental matrix, forced vibrations via modal expansion and transition matrix; Introduction into the dynamic stability theory; Partial differential equations: solution in product form, eigenvalue theory, modal expansion using Ritz series; Variational methods, Hamilton’s principle, boundary value problems representing vibrating continua; Perturbation methods

Organizational issues
Die Vorlesung Mathematische Methoden der Schwingungslehre wird im Sommersemester 2024 nicht angeboten.

Literature
Riemer, Wedig, Wauer: Mathematische Methoden der Technischen Mechanik

Mathematical methods of vibration theory (Tutorial)

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</table>

Content
Seven tutorials with examples of the contents of the course
Organizational issues
Die Vorlesung und Übungen zu Mathematische Methoden der Schwingungslehre werden im Sommersemester 2024 nicht angeboten.

Literature
Riemer, Wedig, Wauer: Mathematische Methoden der Technischen Mechanik
**8.168 Course: Measurement II [T-MACH-105335]**

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

**Part of:**  
- M-MACH-102817 - Major Field: Information Technology  
- M-MACH-102820 - Major Field: Mechatronics

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**Events**

| ST 2024 | 2138326 | Measurement II | 2 SWS | Lecture / 🔴 | Stiller, Steiner |

**Exams**

| WT 23/24 | 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:**

---

**Measurement II**  
2138326, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

<table>
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</table>

**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 might 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

**Arbeitsaufwand:**

120 hours
Literatur
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.
8.169 Course: Mechanical Design I and II [T-MACH-105286]

Responsible: Prof. Dr.-Ing. Sven Matthiesen
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102573 - Mechanical Design

<table>
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Exams

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<td>Mechanical Design I und II</td>
<td>Lecture</td>
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<td>WT 23/24</td>
<td>2 SWS</td>
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<td>Lecture</td>
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<tr>
<td>ST 2024</td>
<td>2 SWS</td>
<td>Mechanical Design I &amp; II</td>
<td>Lecture</td>
<td>Albers, Matthiesen, Düser</td>
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<td>Lecture</td>
<td>Albers, Matthiesen, Düser</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
written exam, graded, duration: 90 min

Prerequisites
Admission to the exam only with successful completion of the T-MACH-105282 - Mechanical Design I, prerequisites and T-MACH-105283 - Mechanical Design II, prerequisites.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105282 - Mechanical Design I, Prerequisites must have been passed.
2. The course T-MACH-105283 - Mechanical Design II, Prerequisites must have been passed.

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

**Mechanical Design I (Lecture)**
3145186, WS 23/24, 2 SWS, Language: English, Open in study portal

Literature

Vorlesungsumdruck:
Der Umdruck zur Vorlesung kann über die eLearning-Plattform Ilias bezogen werden.

Literatur:

Konstruktionselemente des Maschinenbaus - 1 und 2
Grundlagen der Berechnung und Gestaltung von Maschinenelementen;
oder Volltextzugriff über Uni-Katalog der Universitätsbibliothek
Grundlagen von Maschinenelementen für Antriebsaufgaben;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8

**Mechanical Design II Lecture**
3146017, SS 2024, 2 SWS, Language: English, Open in study portal
Content
Bearings
Sealings
Design
Bolted Connections
Tutorials take place in concomitant to the lectures.

Prerequisites
See preliminary workshops.
Further information's will be announced at Ilias and at the beginning of the lecture mechanical design II.

Organizational issues
Place of lecture (Lecture Room/Online) will be communicated on ILIAS

Literature
Konstruktionselemente des Maschinenbaus - 1 und 2
Grundlagen der Berechnung und Gestaltung von Maschinenelementen;
oder Volltextzugriff über Uni-Katalog der Universitätsbibliothek

Grundlagen von Maschinenelementen für Antriebsaufgaben;
8.170 Course: Mechanical Design I, Prerequisites [T-MACH-105282]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102573 - Mechanical Design

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**Exams**

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**Legend:** 🖥 Online, ⚠ Blended (On-Site/Online), ⬤ On-Site, ✗ Cancelled

**Competence Certificate**

Concomitant to the lecture, a workshop with 3 workshop sessions takes place over the semester. During the workshop the students are divided into groups and their mechanical design knowledge will be tested during a colloquium at the beginning of every single workshop session. The attendance is mandatory and will be controlled. The pass of the colloquia and the process of the workshop task are required for the successful participation.

Furthermore an online test is carried out.

**Prerequisites**

none

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

**Mechanical Design I (Tutorial)**

3145187, WS 23/24, 2 SWS, Language: English, Open in study portal

**Practice (Ü)**

Online

**Literature**

Konstruktionselemente des Maschinenbaus - 1 und 2
Grundlagen der Berechnung und Gestaltung von Maschinenelementen;

Grundlagen von Maschinenelementen für Antriebsaufgaben;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8
8.171 Course: Mechanical Design II, Prerequisites [T-MACH-105283]

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

**Part of:** M-MACH-102573 - Mechanical Design

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**Competence Certificate**  
Successful completion of a design task is required to pass the prerequisite.

**Prerequisites**  
None

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

### Mechanical Design II Tutorials  
3146018, SS 2024, 2 SWS, Language: English, [Open in study portal]

**Content**  
Bearings  
Sealings  
Design  
Bolted Connections

**Organizational issues**  
Place of lecture (Lecture Room/Online) will be communicated on ILIAS

**Literature**  
**Konstruktionselemente des Maschinenbaus** - 1 und 2  
Grundlagen der Berechnung und Gestaltung von Maschinenelementen;  

**Grundlagen von Maschinenelementen für Antriebsaufgaben:**  
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8

**CAD:**  
Pro/Engineer Tipps und Techniken, Wolfgang Berg, Hanser Verlag, ISBN: 3-446-22711-3 (für Fortgeschrittene)
8.172 Course: Mechanical Design III and IV [T-MACH-104810]

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

Part of: M-MACH-102573 - Mechanical Design

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Exams

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

Competence Certificate
written exam consisting of:

- written part duration 60 min and
- design part duration 180 min

Sum: 240 min

Prerequisites
Admission to the exam only with successful completion of the Mechanical Design III, Tutorial and Mechanical Design IV, Tutorial.

Modeled Conditions
You have to fulfill one of 2 conditions:

1. The course T-MACH-110955 - Mechanical Design III, Tutorial must have been passed.
2. The course T-MACH-110956 - Mechanical Design IV, Tutorial must have been passed.

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

Mechanical Design III
2145151, WS 23/24, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site
Literatur
Vorlesungsumdruck:
Der Umdruck zur Vorlesung kann über die eLearning-Plattform Ilias bezogen werden.

Literatur:
Konstruktionselemente des Maschinenbaus - 1 und 2
Grundlagen der Berechnung und Gestaltung von Maschinenelementen;
oder Volltextzugriff über Uni-Katalog der Universitätsbibliothek
Grundlagen von Maschinenelementen für Antriebsaufgaben;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8

CAD:
Pro/Engineer Tipps und Techniken, Wolfgang Berg, Hanser Verlag, ISBN: 3-446-22711-3(für Fortgeschrittene)

Mechanical Design III (Lecture)
3145016, WS 23/24, 2 SWS, Language: English, Open in study portal

Literatur
Vorlesungsumdruck:
Der Umdruck zur Vorlesung kann über die eLearning-Plattform Ilias bezogen werden.

Literatur:
Konstruktionselemente des Maschinenbaus - 1 und 2
Grundlagen der Berechnung und Gestaltung von Maschinenelementen;
oder Volltextzugriff über Uni-Katalog der Universitätsbibliothek
Grundlagen von Maschinenelementen für Antriebsaufgaben;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8

CAD:
Pro/Engineer Tipps und Techniken, Wolfgang Berg, Hanser Verlag, ISBN: 3-446-22711-3(für Fortgeschrittene)
8.173 Course: Mechanical Design III, Tutorial [T-MACH-110955]

- **Responsible:** Prof. Dr.-Ing. Sven Matthiesen
- **Organisation:** KIT Department of Mechanical Engineering
- **Part of:** M-MACH-102573 - Mechanical Design

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**Competence Certificate**

Concomitant to the lecture, a workshop with 3 workshop sessions takes place over the semester. During the workshop the students are divided into groups and their mechanical design knowledge will be tested during a colloquium at the beginning of every single CAD-workshop session. The attendance is mandatory and will be controlled. The pass of the colloquia and the process of the workshop task are required for the successful participation.

**Prerequisites**

None

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

- **Tutorials Mechanical Design III**
  - WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Literature**

- **Konstruktionselemente des Maschinenbaus - 1 und 2**
  - Grundlagen der Berechnung und Gestaltung von Maschinenelementen;
- **Grundlagen von Maschinenelementen für Antriebsaufgaben**;
  - Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8
- **CAD:**
  - Pro/Engineer Tipps und Techniken, Wolfgang Berg, Hanser Verlag, ISBN: 3-446-22711-3 (für Fortgeschrittene)

- **Mechanical Design III Workshop**
  - WS 23/24, 1 SWS, Language: German, [Open in study portal](#)
**Course: Mechanical Design III, Tutorial [T-MACH-110955]**

**Literature**

- **Konstruktionselemente des Maschinenbaus** - 1 und 2
  - Grundlagen der Berechnung und Gestaltung von Maschinenelementen;

- **Grundlagen von Maschinenelementen für Antriebsaufgaben**;
  - Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8

**CAD:**

- Pro/Engineer Tipps und Techniken, Wolfgang Berg, Hanser Verlag, ISBN: 3-446-22711-3 (für Fortgeschrittene)

**Mechanical Design III (Tutorial)**

- V 3145017, WS 23/24, 2 SWS, Language: English, [Open in study portal](#)

**Organizational issues**

Termine siehe Lehrveranstaltung 2145154

**Literature**

- **Konstruktionselemente des Maschinenbaus** - 1 und 2
  - Grundlagen der Berechnung und Gestaltung von Maschinenelementen;

- **Grundlagen von Maschinenelementen für Antriebsaufgaben**;
  - Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8

**CAD:**

- Pro/Engineer Tipps und Techniken, Wolfgang Berg, Hanser Verlag, ISBN: 3-446-22711-3 (für Fortgeschrittene)
T 8.174 Course: Mechanical Design IV, Tutorial [T-MACH-110956]

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

Part of: M-MACH-102573 - Mechanical Design

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Exams

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

Competence Certificate
Concomitant to the lecture, a workshop with 3 workshop sessions takes place over the semester. During the workshop the students are divided into groups and their mechanical design knowledge will be tested during a colloquium at the beginning of every single workshop session. The attendance is mandatory and will be controlled. The pass of the colloquia and the process of the workshop task are required for the successful participation.

Prerequisites
None

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

V Mechanical Design IV Workshop
3146022, SS 2024, 1 SWS, Language: English, Open in study portal

Organizational issues
Registration required, information on the IPEK website.

Literature
Konstruktionselemente des Maschinenbaus - 1 und 2
Grundlagen der Berechnung und Gestaltung von Maschinenelementen;

Grundlagen von Maschinenelementen für Antriebsaufgaben;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8

CAD:
Pro/Engineer Tipps und Techniken, Wolfgang Berg, Hanser Verlag, ISBN: 3-446-22711-3 (für Fortgeschrittene)
8.175 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-102819 - Major Field: Materials Science and Engineering

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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 23/24, 2 SWS, Language: German, Open in study portal

Lecture (V) On-Site

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).

Organizational issues
berndvonbernstorff@t-online.de

Literature
Literaturliste, spezielle Unterlagen und ein Teilmanuskript werden in der Vorlesung ausgegeben
8.176 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-102820 - Major Field: Mechatronics

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**Competence Certificate**

Oral examination, ca. 30 min

**Prerequisites**

none

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

### Mechanics in Microtechnology

2181710, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
On-Site

#### Content

1. Introduction: Application and Processing of Microsystems  
2. Scaling Effects  
3. Fundamentals: Stress and Strain, (anisotropic) Hooke's Law  
4. Fundamentals: Mechanics of Beams and Membranes  
5. Thin Film Mechanics: Origin and Role of Mechanical Stresses  
6. Characterization of Mechanical Properties of Thin Films and Small Structures: Measurement of Stresses and 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

2. L.B. Freund and S. Suresh: "Thin Film Materials"  
8.177 Course: Metallographic Lab Class [T-MACH-105447]

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

** Organisation:** KIT Department of Mechanical Engineering

** Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

**Competence Certificate**

Colloquium for every experiment, about 60 minutes, protocol

**Prerequisites**

M-MACH-102562 - Materials Science must be passed.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The module M-MACH-102562 - Materials Science must have been passed.

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

**Metallographic Lab Class**

2175590, WS 23/24, 3 SWS, Language: German, Open in study portal

**Content**

The lab course deals with the practical application of metallographic procedures, e.g. starting from sample extraction to light optical (LOM) and scanning electron microscopy (SEM). The preparation of metallographic samples takes up to two lab days. LOM and SEM analyses are performed on another two days. All results are carefully registered by the students and discussed in a separate session. Finally, the students can independently apply their theoretical and practical knowledge by the preparation and analysis of industrial relevant metallic materials. The content of the lab course will be documented in the form of individual protocols by the students.

Before starting with the lab course, the students need to prepare the fundamentals that are tested in an online test. Lecture notes as starting point are provided.

**Learning objectives:**

The students can perform standard metallographic preparation routines as well as qualitative and quantitative microstructure analysis. The students are able to interpret microstructures and the correlations of microstructural constituent and processing and properties of metallic materials.

**Prerequisites:**

Materials Science and Engineering I and II or Materials Physics and Metals

**Arbeitsaufwand:**

on-site: 25 h
private studies: 95 h
Literatur

Praktikumsskript
Weiterführende Informationen gibt es hier:

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

https://www.ifw-dresden.de/de/ifw-institutes/ikm/lectures/vorlesungsskript-physikalische-werkstoffeigenschaften

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

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

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

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

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

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

http://dx.doi.org/10.1007/978-3-658-13795-3 (frei über die KIT-Lizenz abrufbar)
8.178 Course: Microenergy Technologies [T-MACH-105557]

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

Part of: M-MACH-102816 - Major Field: Fundamentals of Energy Technology
M-MACH-102820 - Major Field: Mechatronics

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

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

Competence Certificate
Oral examination (30 Min.)

Prerequisites
none

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

Microenergy Technologies
2142897, SS 2024, 2 SWS, Language: English, Open in study portal
Lecture (V) On-Site

Content
- Basic physical principles of energy conversion
- Layout and design optimization
- Technologies
- Selected devices
- Applications
The lecture includes amongst others the following topics:

- Micro energy harvesting of vibrations using different conversion principles (piezo, electrostatic, electromagnetic, etc.)
- Thermoelectric energy generation
- Novel thermal energy conversion principles (thermomagnetic, pyroelectric)
- Miniature scale solar devices
- RF energy harvesting
- Miniature scale heat pumping
- Solid-state cooling technologies (magneto-, electro-, mechanocalorics)
- Power management
- Energy storage technologies (microbatteries, supercapacitors, fuel cells)

Literature
- Folienskript "Micro Energy Technologies"
8.179 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-102746 - Compulsory Elective Module

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**Competence Certificate**

Successful participation in the computer internship (ungraded) and written exam, 90 min (graded)

**Prerequisites**

none

**Recommendation**

preliminary knowledge in mathematics, physics and materials science

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

**Numerical methods and simulation techniques**

2183703, WS 23/24, 3 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**

**On-Site**

**Content**

The course gives an introduction to modelling and simulation techniques. The following topics are included:
- splines, interpolation methods, Taylor series
- finite difference method
- dynamical systems
- numerics of partial differential equations
- mass and heat diffusion
- microstructure simulation
- parallel and adaptive algorithms
- high performance computing
- practical exercises

The student can

- explain the basic algorithms and numerical methods which are beside other applications relevant for materials simulations.
- describe and apply numerical solution methods for partial differential equations and dynamical systems
- apply numerical methods to solve heat and mass diffusion problems which can also be used to model microstructure formation processes
- have 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
Termine für Rechnerübungen werden in der Vorlesung bekannt gegeben!

Literature

Modelling and Simulation
2183703, SS 2024, 2+1 SWS, Language: German, Open in study portal
Lecture / Practice (VÜ) On-Site

Content
The course gives an introduction to modelling and simulation techniques.
The following topics are included:
- splines, interpolation methods, Taylor series
- finite difference method
- dynamical systems
- numerics of partial differential equations
- mass and heat diffusion
- microstructure simulation
- parallel and adaptive algorithms
- high performance computing
- practical exercises

The student can

- explain the basic algorithms and numerical methods which are beside other applications relevant for materials simulations.
- describe and apply numerical solution methods for partial differential equations and dynamical systems
- apply numerical methods to solve heat and mass diffusion problems which can also be used to model microstructure formation processes
- has experiences in how to implement and program the introduced numerical methods from an integrated computer lab.

Preliminary knowlegde in mathematics, physics and materials science recommended
Regular attendance: 22.5 hours lecture, 11.5 hours exercises
Self-study: 116 hours

We regularly hand out exercise sheets. In addition, the course will be accompanied by practical exercises at the computer.
Written examination: 90 minutes

Organizational issues

Literature
8.180 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-102746 - Compulsory Elective Module
M-MACH-102819 - Major Field: Materials Science and Engineering

Type: Oral examination
Credits: 5
Grading scale: Grade to a third
Recurrence: Each winter term
Version: 3

Events

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Competence Certificate
oral exam 30 min

Prerequisites
none

Recommendation
materials science
fundamental mathematics

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

**Modelling of Microstructures**
2183702, WS 23/24, 3 SWS, Language: German, [Open in study portal](#)

**Lecture / Practice (VÜ)**
On-Site

Content

- Brief Introduction in thermodynamics
- Gibbs free energy and phase diagrams
- Free energy functional
- Phase-field equation
- Driving forces
- Grand chemical potential functional and the evolution equations
- Numeric solution of the phase-field equation

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.
- explain the mechanisms of phase boundary motion induced under driving forces
- use the phase-field method for simulation of microstructure formation processes
- have 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
oral exam ca. 30 min
Organizational issues
Der erste Termin (am 27.10.2023) findet ausnahmsweise ohne die Dozentin statt. Bitte schauen Sie sich an diesem Termin die erste Aufzeichnung der Vorlesung an (s. das entsprechende Verzeichnis bei ILIAS).

Terminvereinbarung für die mündliche Prüfung: Sobald Sie wissen, wann Sie die Prüfung ablegen möchten, schreiben Sie bitte eine Mail an die Prüferin Anastasia August (anastasia.august2@kit.de) und schlagen Sie einen oder mehrere Termin/e vor. Die Prüfung dauert ca. 30 Minuten.

Literature
4. Gaskell, D.R., Introduction to the thermodynamics of materials
8.181 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-102820 - Major Field: Mechatronics

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<th>Credits</th>
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<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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<tr>
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<th>ST 2024</th>
<th>Modern Control Concepts I</th>
<th>2 SWS</th>
<th>Lecture / Online</th>
<th>Matthes, Groell</th>
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<td>Tutorial on Modern Control Concepts I</td>
<td>2 SWS</td>
<td>Practice / Online</td>
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**Exams**

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<td>Modern Control Concepts I</td>
<td>Matthes</td>
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</table>

**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 2024, 2 SWS, Language: German, Open in study portal

**Tutorial on Modern Control Concepts I**

2106020, SS 2024, 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

8.182 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-102812 - Major Field: Powertrain Systems  
M-MACH-102820 - Major Field: Mechatronics

Type: Written examination  
Credits: 4  
Grading scale: Grade to a third  
Recurrence: Each winter term  
Version: 3

Events

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<th>Events</th>
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<td>Novel actuators and sensors</td>
<td>Lecture / On-Site</td>
<td>Kohl, Sommer</td>
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<td>Novel Actuators and Sensors</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
written exam, 60 minutes

Prerequisites
none

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

Novel actuators and sensors
2141865, WS 23/24, 2 SWS, Language: German, Open in study portal

Lecture (V)  
On-Site

Literature
- Vorlesungsskript " Neue Aktoren" und Folienskript "Sensoren"
- Donald J. Leo, Engineering Analysis of Smart Material Systems, John Wiley & Sons, Inc., 2007
8.183 Course: Numerical Fluid Mechanics [T-MACH-105338]

**Responsible:** Dr.-Ing. Davide Gatti  
Dr.-Ing. Franco Magagnato

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102816 - Major Field: Fundamentals of Energy Technology  
M-MACH-102838 - Major Field: Energy Converting Engines

<table>
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**Events**

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<td>Lecture / Practice (VÜ)</td>
<td>Gatti</td>
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</table>

**Competence Certificate**
oral exam - 30 minutes

**Prerequisites**
none

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

**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**
Competence Certificate
An oral examination according to § 7 section 6 of approx. 45 minutes on the contents of two courses from In-depth Module.

Prerequisites
Prerequisite for the ‘Oral Examination’ is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.
8.185 Course: Oral Exam - Supplementary Studies on Sustainable Development [T-ZAK-112351]

Organisation:
Part of: M-ZAK-106099 - Supplementary Studies on Sustainable Development

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<td>Grade to a third</td>
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</table>

**Competence Certificate**
An oral examination according to § 7 section 6 of approx. 45 minutes on the contents of two courses from Elective Module.

**Prerequisites**
A requirement for the Supplementary Course: Oral examination is the successful completion of the modules Basics Module and Specialisation Module and the required electives of Elective Module.
### 8.186 Course: Photovoltaics [T-ETIT-101939]

**Responsible:** Prof. Dr.-Ing. Michael Powalla  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy 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

**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-102816 - Major Field: Fundamentals of Energy Technology

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<td>Each winter term</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:

**Physical and chemical principles of nuclear energy in view of reactor accidents and back-end of nuclear fuel cycle**  
2189906, WS 23/24, 2 SWS, Language: German, Open in study portal
Content

- Relevant physical terms of nuclear physics
- Decay heat removal- Borst-Wheeler equation
- The accidents in TMI- Three Mile Island, and Fukushima.
- Fission, chain reaction and reactor control systems
- Basics of nuclear cross sections
- Principles of reactor dynamics
- Reactor poisoning
- The Idaho and Chernobyl accidents
- Principles of the nuclear fuel cycle
- Reprocessing of irradiated fuel elements and vitrification of fission product solutions
- Interim storage of nuclear residues in surface facilities
- Multi barrier concepts for final disposal in deep geological formations
- The situation in the repositories Asse II, Konrad and Morsleben

The students

- understand the physical explanations of the known nuclear accidents
- can perform simplified calculations to demonstrate the accidents outcome.
- Define safety relevant properties of low/ intermediate / high level waste products
- Are able to evaluate principles and implications of reprocessing, storage and disposal options for nuclear waste.

Regular attendance: 14 h
self study 46 h
oral exam about 20 min.

Organizational issues

Die Veranstaltung wird nur online gehalten, falls durch Corona Einschränkungen vorgegeben werden.

Literature

AEA öffentliche Dokumentation zu den nuklearen Ereignissen
K. Wirtz: Grundlagen der Reaktortechnik Teil I, II, Technische Hochschule Karlsruhe 1966
J. Duderstadt and L. Hamilton: Nuclear reactor Analysis, J. Wiley & Sons, Inc. 1975 (in Englisch)
8.188 Course: Physical Basics of Laser Technology [T-MACH-102102]

Responsible: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102746 - Compulsory Elective Module

Type | Credits | Grading scale | Recurrence | Version
--- | --- | --- | --- | ---
Oral examination | 5 | Grade to a third | Each winter term | 4

Events

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<th>Grade to a third</th>
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<td>Lecture / Practice ( / )</td>
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Exams

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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 Material Processing [T-MACH-112763], 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-112763 - Laser Material Processing must not have been started.

Recommendation
Basic knowledge of physics, chemistry and material science

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

Physical basics of laser technology
2181612, WS 23/24, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site
Content
Based on the description of the physical basics about the formation and the properties of laser light the lecture goes through the different types of laser beam sources used in industry these days. The lecture focuses on the usage of lasers especially in materials engineering. Other areas like measurement technology or medical applications are also mentioned.

- physical basics of laser technology
- laser beam sources (solid state, diode, gas, liquid and other lasers)
- beam properties, guiding and shaping
- lasers in materials processing
- lasers in measurement technology
- lasers for medical applications
- 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
8.189 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-102746 - Compulsory Elective Module

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

| ST 2024 | 2142890 | Physics for Engineers | 4 SWS | Lecture / Practice ( / ) | Weygand, Dienwiebel, Nesterov-Müller, Gumbsch |

**Exams**

| WT 23/24 | 76-T-MACH-100530 | Physics for Engineers |  | Gumbsch, Dienwiebel, Nesterov-Müller, Weygand |
| ST 2024  | 76-T-MACH-100530 | Physics for Engineers |  | Gumbsch, Weygand, Nesterov-Müller, 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:**

**Physics for Engineers**
2142890, SS 2024, 4 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
On-Site
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 (exercises)
self-study: 105 hours
The assessment consists of a written exam (90 minutes) (following §4(2), 1 of the examination regulation).
Organizational issues
Kontakt: daniel.weygand@kit.edu
Literature
   • Tipler und Mosca: Physik für Wissenschaftler und Ingenieure, Elsevier, 2004
   • Harris, Moderne Physik, Pearson Verlag, 2013
8.190 Course: PLM-CAD Workshop [T-MACH-102153]

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

Part of: M-MACH-102583 - Major Field: Information Management

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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 exam assessment (graded)

Prerequisites
None

Annotation
Number of participants is limited, compulsory attendance

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

PLM-CAD Workshop
2121357, WS 23/24, 4 SWS, Language: German, Open in study portal
Project (PRO) On-Site

Content
The aim of the workshop is to demonstrate the benefits of collaborative product development using PLM methods and to emphasize their added value compared to classical CAD development.

Students learn how to develop and produce a prototype with the help of modern PLM and CAx systems.

Literature
Workshop-Unterlagen / workshop materials

PLM-CAD Workshop
2121357, SS 2024, 4 SWS, Language: German, Open in study portal

Content
The aim of the workshop is to demonstrate the benefits of collaborative product development using PLM methods and to emphasize their added value compared to classical CAD development.

Students learn how to develop and produce a prototype with the help of modern PLM and CAx systems.

Organizational issues
Siehe Homepage zur Lehrveranstaltung

Literature
Workshop-Unterlagen / workshop materials
8.191 Course: Polymer Engineering I [T-MACH-102137]

Responsible: Dr.-Ing. Wilfried Liebig
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102819 - Major Field: Materials Science and Engineering

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

Events

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<td>WT 23/24</td>
<td>2173590</td>
<td>Polymer Engineering I</td>
<td>2 SWS</td>
<td>Lecture / Liebig</td>
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Exams

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

Competence Certificate

Oral exam, about 25 minutes

Prerequisites
none

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

V Polymer Engineering I
2173590, WS 23/24, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

Literature

Literaturhinweise, Unterlagen und Teilmanuskript werden in der Vorlesung ausgegeben.
8.192 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-102812 - Major Field: Powertrain Systems  
M-MACH-102815 - Major Field: Engineering Design  
M-MACH-102818 - Major Field: Vehicle Technology  

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<td>Powertrain Systems Technology A: Automotive Systems</td>
<td>2 SWS</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 A: Automotive Systems**

2146180, SS 2024, 2 SWS, Language: German, Open in study portal

**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
8.193 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-102812 - Major Field: Powertrain Systems
M-MACH-102815 - Major Field: Engineering Design

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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 23/24, 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: "Schaltbare fremdbetätigte Reibkupplungen und -bremsen", VDI Verlag GmbH, Düsseldorf
8.194 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-102820 - Major Field: Mechatronics  
M-MACH-104442 - Major Field: Vibration Theory

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<th>Schwingungstechnisches Praktikum</th>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗓 On-Site, ⏳ Cancelled

**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: Practice Module [T-ZAK-112660]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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Competence Certificate
Internship (3 ECT)
Report within the framework of the practical training (Length approx. 18,000 characters (incl. spaces) (1 ECT)

Prerequisites
none

Annotation
Knowledge from the Basic Module and the Elective Module is helpful.
### 8.196 Course: Presentation [T-MACH-109189]

**Responsible:** Prof. Dr.-Ing. Martin Heimmaier  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104494 - Bachelor's Thesis

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**Competence Certificate**
The colloquium presentation must be held within 6 weeks after the submission of the bachelor thesis. The presentation should last around 20 minutes followed by a scientific discussion with the present expert audience. The students should show that they are able to independently present and discuss the content of their bachelor thesis according to scientific criteria.

**Prerequisites**  
Bachelor Thesis has been started

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

1. The course T-MACH-109188 - Bachelor’s Thesis must have been started.

**Annotation**
The workload for the presentation of the bachelor thesis is about 90 hours.
Course: Principles of Ceramic and Powder Metallurgy Processing [T-MACH-102111]

 Responsible: apl. Prof. Dr. Günter Schell
 Organisation: KIT Department of Mechanical Engineering
 Part of: M-MACH-102819 - Major Field: Materials Science and Engineering

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

Competence Certificate
The assessment consists of an oral exam (20-30 min) taking place at the agreed date. The re-examination is offered upon agreement.

Prerequisites
none

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

Basic principles of powder metallurgical and ceramic processing
2193010, WS 23/24, 2 SWS, Language: German, Open in study portal

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

Literature

- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005
8 COURSES
Course: Product- and Production-Concepts for Modern Automobiles [T-MACH-110318]

8.198 Course: Product- and Production-Concepts for Modern Automobiles [T-MACH-110318]

Responsible: Dr. Stefan Kienzle
Dr. Dieter Steegmüller

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102818 - Major Field: Vehicle Technology

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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

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

2149670, WS 23/24, 2 SWS, Language: German, Open in study portal

Lecture (V) Blended (On-Site/Online)
Content
The lecture illuminates the practical challenges of modern automotive engineering. As former leaders of the automotive industry, the lecturers refer to current aspects of automotive product development and production.

The aim is to provide students with an overview of technological trends in the automotive industry. In this context, the course also focuses on changes in requirements due to new vehicle concepts, which may be caused by increased demands for individualisation, digitisation and sustainability. The challenges that arise in this context will be examined from both a production technology and product development perspective and will be illustrated with practical examples thanks to the many years of industrial experience of both lecturers.

The topics covered are:

- General conditions for vehicle and body development
- Integration of new drive technologies
- Functional requirements (crash safety etc.), also for electric vehicles
- Development Process at the Interface Product & Production, CAE/Simulation
- Energy storage and supply infrastructure
- Aluminium and lightweight steel construction
- FRP and hybrid parts
- Battery, fuel cell and electric motor production
- Joining technology in modern car bodies
- Modern factories and production processes, Industry 4.0.

Learning Outcomes:
The students ...

- are able to name the presented general conditions of vehicle development and are able to discuss their influences on the final product using practical examples.
- are able to name the various lightweight approaches and identify possible areas of application.
- are able to identify the different production processes for manufacturing lightweight structures and explain their functions.
- are able to perform a process selection based on the methods and their characteristics.

Workload:
regular attendance: 25 hours
self-study: 95 hours

Organizational issues
Termine werden über Ilias bekannt gegeben.
Bei der Vorlesung handelt es sich um eine Blockveranstaltung. Eine Anmeldung über Ilias ist erforderlich.
Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (https://www.karlsruher-forschungsfabrik.de) unterstützt.
The lecture is a block course. An application in Ilias is mandatory.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (https://www.karlsruher-forschungsfabrik.de/en.html) to deepen the acquired knowledge.

Literature
Medien:
Skrift zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
8.199 Course: Product Lifecycle Management [T-MACH-105147]

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

Part of:
- M-MACH-102583 - Major Field: Information Management
- M-MACH-102589 - Major Field: Production Systems
- M-MACH-102746 - Compulsory Elective Module

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

Events

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Exams

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

Competence Certificate
Written examination 90 min.

Prerequisites
None

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

**Product Lifecycle Management**

2121350, WS 23/24, 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.


8.200 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-102583 - Major Field: Information Management  
M-MACH-102818 - Major Field: Vehicle Technology

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**Exams**

| WT 23/24 | 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**

Lecture / Practice (VÜ)

2123364, SS 2024, 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
8.201 Course: Production Technology for E-Mobility [T-MACH-110984]

Responsible: Prof. Dr.-Ing. Jürgen Fleischer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102815 - Major Field: Engineering Design
M-MACH-102816 - Major Field: Fundamentals of Energy Technology
M-MACH-102818 - Major Field: Vehicle Technology

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Events

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<th>2150605</th>
<th>Production Technology for E-Mobility</th>
<th>2 SWS</th>
<th>Lecture / 🗣</th>
<th>Fleischer</th>
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</thead>
</table>

Exams

| WT 23/24 | 76-T-MACH-110984 | Production Technology for E-Mobility | Fleischer |

Competition Certificate
Written Exam (60 min)

Prerequisites

none

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

V Production Technology for E-Mobility
2150605, SS 2024, 2 SWS, Language: German, Open in study portal

Lecture (V) On-Site

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 battery system.
- 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
Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (https://www.karlsruher-forschungsfabrik.de) unterstützt.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (https://www.karlsruher-forschungsfabrik.de/en.html) to deepen the acquired knowledge.
Literature
Skript zur Veranstaltung wird über Ilias (https://ilias.studium.kit.edu/) bereitgestellt.
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)
8.202 Course: Programming in CAE-Applications [T-MACH-111431]

Responsible: Prof. Dr.-Ing. Luise Kärger
Organisation: KIT Department of Mechanical Engineering
Lightweight Design
Part of: M-MACH-102815 - Major Field: Engineering Design

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Exams

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<td>76-T-MACH-111431</td>
<td>Programming in CAE-Applications</td>
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</table>

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 23/24, 2 SWS, Language: German, Open in study portal
Practical course (P)
Blended (On-Site/Online)
Content
The development of components supported by numerical simulations, for example through the finite element method (FEM), has become an indispensable part of modern engineering work. They allow a virtual evaluation of different component variants and thus contribute to an efficient product development process. For the correct use of CAE methods and the generation of reliable simulation results, knowledge of the methodological background and a goal-oriented approach for the model setup and simulation evaluation is essential. Thereby, recurring problems can be solved efficiently and automatically by programming sequence and evaluation scripts. The investigation of modern material systems such as continuous fiber-reinforced plastics represents an additional challenge. For these complex materials, there is often a lack of commercially available methods, which is why the implementation of user-defined material models through suitable subroutines is increasingly necessary.

In this workshop, students learn about the everyday work of computational engineers. Step by step, the basics of the finite element method are worked out using practical examples in Abaqus, as well as typical procedures for model setup and evaluation. Building on this, basic knowledge of script programming in Python and the implementation of material models in Fortran subroutines is taught. The aim of the course is to illustrate the contents in an application-oriented manner through a combination of lectures, supervised classroom exercises and solving project tasks in small groups during the semester.

Main topics:
- Fundamentals of FE structural simulations with anisotropic materials using continuous fiber-reinforced plastics as an example (Abaqus)
- Automated model setup and evaluation with Python scripts
- Efficient evaluation of the result quality of FE-simulations
- Derivation of measures to improve structural load-bearing capacity
- User-defined material modelling (Fortran subroutines)

Learning Objectives:
Students will be able to
- understand the basics of the finite element method and use the FE software Abaqus to solve practical calculation tasks,
- automate the FE model generation as well as the result evaluation,
- evaluate the simulation results, identify errors and derive conclusions for improving the load-bearing capacity,
- understand the basics for developing material subroutines and implement them for simple examples.

Organizational issues
Die Veranstaltung findet immer dienstags um 15:45 Uhr am Campus Ost in Geb. 70.04, Raum 219 statt.


The event takes place every Tuesday at 3:45 p.m. on Campus East in building 70.04, room 219.

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.
8.203 Course: Project Internship Additive Manufacturing: Development and Production of an Additive Component [T-MACH-110960]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102589 - Major Field: Production Systems
- M-MACH-102815 - Major Field: Engineering Design
- M-MACH-102819 - Major Field: Materials Science and Engineering

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**Events**

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**Exams**

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<td>Zanger</td>
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**Legend:**
- Online
- Blended (On-Site/Online)
- On-Site
- Cancelled

**Competence Certificate**

*Alternative test achievement (graded)*

The competence certificate is a project work; alternative test achievement according to § 4 Abs. 2 No. 3 of the SPO. Here, the project work, the milestone-based presentation of the results in presentation form (10 min each) and a final oral examination (15 min) are included in the assessment.

**Prerequisites**

none

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

**Project Internship Additive Manufacturing: Development and Production of an Additive Component**

2149700, WS 23/24, 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).
- 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

Aus organisatorischen Gründen ist die Teilnehmerzahl für die Lehrveranstaltung begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Der Link zur Bewerbung wird in der Vorlesungsankündigung über die Homepage des wbk (http://www.wbk.kit.edu/studium-und-lehre.php) zur Verfügung gestellt.

Literature
Skript zur Veranstaltung wird über ilias (https://ilias.studium.kit.edu/) bereitgestellt.
8.204 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-102818 - Major Field: Vehicle Technology

<table>
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**Exams**

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<td>Each term</td>
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**Type:** Oral examination  
**Credits:** 6  
**Grading scale:** Grade to a third  
**Recurrence:** Each term  
**Version:** 1

**Competence Certificate**

Oral examination  

**Duration:** 30 up to 40 minutes  
**Auxiliary means:** none

**Prerequisites**

none

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

**Project Workshop: Automotive Engineering**

2115817, WS 23/24, 3 SWS, Language: German, Open in study portal  

**Lecture (V)**  
On-Site

**Content**

During the Project Workshop Automotive Engineering a team of six persons will work on a task given by an German industrial partner using the instruments of project management. The task is relevant for the actual business and the results are intended to be industrialized after the completion of the project workshop.

The team will generate approaches in its own responsibility and will develop solutions for practical application. Coaching will be supplied by both, company and institute.

At the beginning in a start-up meeting goals and structure of the project will be specified. During the project workshop there will be weekly team meetings. Also a milestone meeting will be held together with persons from the industrial company. In a final presentation the project results will be presented to the company management and to institute representatives.

**Learning Objectives:**

During the Project Workshop Automotive Engineering a team of six persons will work on a task given by an German industrial partner using the instruments of project management. The task is relevant for the actual business and the results are intended to be industrialized after the completion of the project workshop.

The team will generate approaches in its own responsibility and will develop solutions for practical application. Coaching will be supplied by both, company and institute.

At the beginning in a start-up meeting goals and structure of the project will be specified. During the project workshop there will be weekly team meetings. Also a milestone meeting will be held together with persons from the industrial company. In a final presentation the project results will be presented to the company management and to institute representatives.
Organizational issues
Begrenzte Teilnehmerzahl mit Auswahlverfahren, in deutscher Sprache. Bewerbungen sind am Ende des vorhergehenden Semesters einzureichen.
Termin und Raum: siehe Institutshomepage.
Limited number of participants with selection procedure, in German language. Please send the application at the end of the previous semester.
Date and room: see homepage of institute.

Literature

Skripte werden beim Start-up Meeting ausgegeben.
The scripts will be supplied in the start-up meeting.

Project Workshop: Automotive Engineering
2115817, SS 2024, 3 SWS, Language: German, Open in study portal

Learning Objectives:
The students are familiar with typical industrial development processes and working style. They are able to apply knowledge gained at the university to a practical task. They are able to analyze and to judge complex relations. They are ready to work self-dependently, to apply different development methods and to work on approaches to solve a problem, to develop practice-oriented products or processes.

Organizational issues
Begrenzte Teilnehmerzahl mit Auswahlverfahren, die Bewerbungen sind am Ende des vorhergehenden Semesters einzureichen.

Raum und Termine: s. Aushang bzw. Homepage.

Literature

Skripte werden beim Start-up Meeting ausgegeben.
8.205 Course: Python Algorithm for Vehicle Technology [T-MACH-110796]

Responsible: Stephan Rhode
Organisation: M-MACH-102818 - Major Field: Vehicle Technology

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Events

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Exams

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<tr>
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<td>Python Algorithm for Vehicle Technology</td>
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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 2024, 2 SWS, Language: German, Open in study portal

Lecture (V) Cancelled

Content

Teaching content:

- Introduction to Python and useful tools and libraries for creating algorithms, graphical representation, optimization, symbolic arithmetic and machine learning
  - Anaconda, Pycharm, Jupyter
  - NumPy, Matplotlib, SymPy, Scikit-Learn
- Methods and tools for creating software
  - Version management GitHub, git
  - Testing software pytest, Pylint
  - Documentation Sphinx
  - Continuous Integration (CI) Travis CI
  - Workflows in Open Source and Inner Source, Kanban, Scrum
- Practical programming projects to:
  - Road sign recognition
  - Vehicle state estimation
  - Calibration of vehicle models by mathematical optimization
  - Data-based modelling of the powertrain of an electric vehicle

Objectives:

The students have an overview of the programming language Python and important Python libraries to solve automotive engineering problems with computer programs. The students know current tools around Python to create algorithms, to apply them and to interpret and visualize their results. Furthermore, the students know basics in the creation of software to be used in later programming projects in order to develop high-quality software solutions in teamwork. Through practical programming projects (road sign recognition, vehicle state estimation, calibration, data-based modelling), the students can perform future complex tasks from the area of driver assistance systems.

Organizational issues

Die Vorlesung wird im erst wieder im Sommersemester 2025 stattfinden.
### Literature

8.206 Course: Quality Management [T-MACH-102107]

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

**Part of:**  
- M-MACH-102589 - Major Field: Production Systems  
- M-MACH-102815 - Major Field: Engineering Design  
- M-MACH-102821 - Major Field: Technical Logistics

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

**Prerequisites**  
It is not possible to combine this brick with brick Quality Management [T-MACH-112586].

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

**Quality Management**  
2149667, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
Content
Based on the quality philosophies Total Quality Management (TQM) and Six Sigma, the lecture deals with the requirements of modern quality management. Within this context, the process concept of a modern enterprise and the process-specific fields of application of quality assurance methods are presented. The lecture covers the current state of the art in preventive and non-preventive quality management methods in addition to manufacturing metrology, statistical methods and service related quality management. The content is completed with the presentation of certification possibilities and legal quality aspects.

Main topics of the lecture:
- The term "Quality"
- Total Quality Management (TQM) and Six Sigma
- Universal methods and tools
- QM during early product stages – product definition
- QM during product development and in procurement
- QM in production – manufacturing metrology
- QM in production – statistical methods
- QM in service
- Quality management systems
- Legal aspects of QM

Learning Outcomes:
The students …
- are capable to comment on the content covered by the lecture.
- are capable of substantially quality philosophies.
- are able to apply the QM tools and methods they have learned about in the lecture to new problems from the context of the lecture.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques they have learned about in the lecture for a specific problem.

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

Organizational issues
Vorlesungstermine montags 09:45 Uhr
Übung erfolgt während der Vorlesung

Literature
Medien:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt:

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
8.207 Course: Rail System Technology [T-MACH-106424]

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

**Part of:** M-MACH-102638 - Major Field: Rail System Technology

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**Events**

| WT 23/24 | 2115919 | Rail System Technology | 2 SWS | Lecture / 🗣 | Cichon, Heckele |
| ST 2024  | 2115919 | Rail System Technology | 2 SWS | Lecture / 🗣 | Cichon |

**Exams**

| WT 23/24 | 76-T-MACH-106424 | Rail System Technology | Cichon, Heckele, Reimann |
| ST 2024  | 76-T-MACH-106424 | Rail System Technology | Cichon, Berthold |

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

**Competence Certificate**

written examination in German language  
Duration: 60 minutes  
No tools or reference materials may be used during the exam except calculator and dictionary

**Prerequisites**

none

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

### Lecture (V) On-Site

**Rail System Technology**  
2115919, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Content**

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact  
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling  
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram  
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return  
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles  
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control  
7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

**Literature**

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

### Lecture (V) On-Site

**Rail System Technology**  
2115919, SS 2024, 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
ab SS 2024 schriftliche Prüfung

Literature
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.
A bibliography is available for download (Ilias-platform).
8.208 Course: Rail Vehicle Technology [T-MACH-105353]

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

Part of: M-MACH-102638 - Major Field: Rail System Technology

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<td>2 SWS</td>
<td>Lecture / Online</td>
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Exams

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<td>2 SWS</td>
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<td>Cichon, Berthold</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
written examination in German language
Duration: 60 minutes
No tools or reference materials may be used during the exam except calculator and dictionary

Prerequisites
none

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

**Rail Vehicle Technology**
2115996, WS 23/24, 2 SWS, Language: German, [Open in study portal]

Lecture (V)
On-Site

Content

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, coupling, doors and windows
3. Bogies: forces, running gears, bogies, Jakobs-bogies, active components, connection to car body, wheel arrangement
4. Drives: principles, electric drives (main components, asynchronous traction motor, inverter, with DC supply, with AC supply, without line supply, multisystem vehicles, dual mode vehicles, hybrid vehicles), non-electric drives
5. Brakes: basics, principles (wheel brakes, rail brakes, blending), brake control (requirements and operation modes, pneumatic brake, electropneumatic brake, emergency brake, parking brake)
6. Train control management system: definition of TCMS, bus systems, components, network architectures, examples, future trends

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

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, coupling, doors and windows
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6. Train control management system: definition of TCMS, bus systems, components, network architectures, examples, future trends

Organizational issues
ab SS 2024 schriftliche Prüfung

Literature
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.
A bibliography is available for download (Ilias-platform).
**8.209 Course: Railways in the Transportation Market [T-MACH-105540]**

**Responsible:** Prof. Dr.-Ing. Martin Cichon  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102638 - Major Field: Rail System Technology

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**Exams**

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<tr>
<td>ST 2024</td>
<td>76-T-MACH-105540</td>
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</table>

**Competence Certificate**

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

**Prerequisites**

- none

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

**Railways in the Transportation Market**

**2114914, SS 2024, 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

Literature
keine
8.210 Course: Re:Invent - Revolutionary Business Models as the Basis for Product Innovations [T-MACH-111888]

**Responsible:** Dr.-Ing. Thomas Schneider

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102815 - Major Field: Engineering Design

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**Events**

| ST 2024 | 2147177 | Re:Invent - Revolutionary Business Models as the Basis for Product Innovations (Lecture) | 2 SWS | Lecture / 🗣 | Schneider |

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

**Competence Certificate**

Oral exam, duration: approx. 20 minutes

**Prerequisites**

None
8.211 Course: Reliability Engineering 1 [T-MACH-107447]

**Responsible:** Dr.-Ing. Alexei Konnov

**Organisation:** KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery

**Part of:** M-MACH-102817 - Major Field: Information Technology
M-MACH-102838 - Major Field: Energy Converting Engines

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**Competence Certificate**
written exam

**Prerequisites**
none
8.212 Course: Robotics I - Introduction to Robotics [T-INFO-108014]

**Responsible:** Prof. Dr.-Ing. Tamim Asfour  
**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-102820 - Major Field: Mechatronics

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**Exams**

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**Competence Certificate**

The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 60 minutes.

**Prerequisites**

none.
8.213 Course: Safety Engineering [T-MACH-105171]

**Responsible:** Hans-Peter Kany  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-102815 - Major Field: Engineering Design  
- M-MACH-102821 - Major Field: Technical Logistics

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**Events**

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<th>76-T-MACH-105171</th>
<th>Safety Engineering</th>
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**Competition 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 23/24, 2 SWS, Language: German, [Open in study portal]

**Learning content**

The course provides basic knowledge of safety engineering. In particular the basics of health at the working place, job safety in Germany, national and European safety rules and the basics of safe machine design are covered. The implementation of these aspects will be illustrated by examples of material handling and storage technology. This course focuses on: basics of safety at work, safety regulations, basic safety principles of machine design, protection devices, system security with risk analysis, electronics in safety engineering, safety engineering for storage and material handling technique, electrical dangers and ergonomics. So, mainly, the technical measures of risk reduction in specific technical circumstances are covered.

**Learning goals**

The students are able to:

- Name and describe relevant safety concepts of safety engineering,
- Discuss basics of health at work and labour protection in Germany,
- Evaluate the basics for the safe methods of design of machinery with the national and European safety regulations and
- Realize these objectives by using examples in the field of storage and material handling systems.

**Recommendations**

None

**Workload**

Regular attendance: 21 hours  
Self-study: 99 hours

**Organizational issues**

Termine: siehe ILIAS.

**Literature**

Deffen/Wickert: Sicherheit für den Maschinen- und Anlagenbau, Druckerei und  
Verlag: H. von Ameln, Ratingen
8.214 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-102746 - Compulsory Elective Module

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**Exams**

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<td>Grade to a third</td>
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</table>

**Competence Certificate**

Written exam (90 minutes)

**Prerequisites**

The brick can not be combined with the brick "Application of advanced programming languages in mechanical engineering" (T-MACH-105390).

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

**Scientific computing for Engineers**

2181738, WS 23/24, 2 SWS, Language: German, Open in study portal

Lecture (V) On-Site
Content

1. Introduction: why scientific computing
2. computer architectures
3. Introduction to Unix/Linux
4. Foundations of C++
   * program organization
   * data types, operator, control structures
   * dynamic memory allocation
   * functions
   * class
   * OpenMP parallelization
5. numeric algorithms
   * finite differences
   * MD simulations: 2nd order differential equations
   * algorithms for particle simulations
   * solver for linear systems of eqns.

The student can

- apply the programming language C++ for scientific computing in the field of materials science
- adapt programs for use on parallel platforms
- choose suitable numerical methods for the solution of differential equations.

The lecture can not be combined with the lecture "Application of advanced programming languages in mechanical engineering" (2182735).

regular attendance: 22.5 hours
Lab: 22.5 hours (optional)
self-study: 75 hours
written exam 90 minutes

Literature

1. C++: Einführung und professionelle Programmierung; U. Breymann, Hanser Verlag München
2. C++ and object-oriented numeric computing for Scientists and Engineers, Daoqui Yang, Springer Verlag.
3. The C++ Programming Language, Bjarne Stroustrup, Addison-Wesley
4. Die C++ Standardbibliothek, S. Kuhlins und M. Schader, Springer Verlag

Numerik:

1. Numerical recipes in C++ / C / Fortran (90), Cambridge University Press
2. Numerische Mathematik, H.R. Schwarz, Teubner Stuttgart
3. Numerische Simulation in der Moleküldynamik, Griebel, Knapek, Zumbusch, Caglar, Springer Verlag

Exercises for Scientific Computing for Engineers

2181739, WS 23/24, 2 SWS, Language: German, Open in study portal

Practice (Ü) On-Site

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)
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-102816 - Major Field: Fundamentals of Energy Technology

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Events

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<td>Lecture / 🗣</td>
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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 2024, 2 SWS, Language: German/English, Open in study portal

Lecture (V)
On-Site

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)
Course: Self-Booking-BSc-HOC-SPZ-ZAK-Graded [T-MACH-111685]

- **Responsible:** Prof. Dr.-Ing. Martin Heilmaier
- **Organisation:** KIT Department of Mechanical Engineering
- **Part of:** M-MACH-102576 - Key Competences

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<td>Each term</td>
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**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".
8.217 Course: Self-Booking-BSc-HOC-SPZ-ZAK-Non-Graded [T-MACH-111684]

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

Part of: M-MACH-102576 - 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”.
# 8.218 Course: Seminar for Rail System Technology [T-MACH-108692]

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

**Part of:** M-MACH-102638 - Major Field: Rail System Technology

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**Events**

| WT 23/24 | 2115009 | Seminar for Rail System Technology | 2 SWS | Seminar / 🗣 | Cichon |
| ST 2024  | 2115009 | Seminar for Rail System Technology | 2 SWS | Seminar / 🗣 | Cichon, Ziesel |

**Exams**

| WT 23/24 | 76-T-MACH-2115009 | Seminar for Rail System Technology | Cichon |
| ST 2024  | 76-T-MACH-2115009 | Seminar for Rail System Technology | Cichon |

**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, WS 23/24, 2 SWS, Language: German, [Open in study portal](https://www.fast.kit.edu/bst/929_11545.php)

### 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 (mile stones), 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 Einführungsveranstaltung findet am 15.11.2023 13.00-16.00 Uhr am Campus Ost, 70.04, R 008 statt. Die Prüfung besteht aus einer schriftlichen Ausarbeitung (Seminararbeit - ca. 20 Seiten Inhalt) und einem Vortrag über die Ausarbeitung. Weitere Infos siehe Instituts homepage [https://www.fast.kit.edu/bst/929_11545.php](https://www.fast.kit.edu/bst/929_11545.php).

Max. 10 participants. Examination: Writing a Seminararbeit (ca. 20 pages content), final presentation. Please check the homepage for further information.


**Content**

1. Railway System: railway as a system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact.
4. 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.
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 Einführungsveranstaltung findet am 08.05.2024 13.00-16.00 Uhr am Campus Ost, 70.04, R 008 statt. Die Prüfung besteht aus einer schriftlichen Ausarbeitung (Seminararbeit - ca. 20 Seiten Inhalt) und einem Vortrag über die Ausarbeitung. Weitere Infos siehe Institutshomepage [https://www.fast.kit.edu/bst/929_11545.php](https://www.fast.kit.edu/bst/929_11545.php).

Max. 10 participants. Examination: Writing a Seminararbeit (ca. 20 pages content), 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).
# 8.219 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-102820 - Major Field: Mechatronics

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<td>2 SWS</td>
<td>Lecture / 📚</td>
<td>Wahls, Heizmann</td>
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**Exams**

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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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics

### Events

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### Exams

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**Competence Certificate**

The assessment consists of an oral exam (20 min) taking place in the recess period. 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 hydraulics simulation programs
- Possibilities of coupled simulations
- Modelling and Simulation of Mobile Machines using a wheel loader
- Documentation of the result in a short report

### Literature

- Software guide books (PDFs)
- Information about wheel-type loader specifications

*Below you will find excerpts from events related to this course:*
Simulation of Coupled Systems
2114095, SS 2024, 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
### 8.221 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-104430 - Major Field: Modeling and Simulation in Dynamics |
| **Type**                  | Completed coursework         |
| **Credits**                | 0                          |
| **Grading scale**          | pass/fail                   |
| **Recurrence**             | Each summer term            |
| **Version**                | 1                          |

#### Exams

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<td>Simulation of Coupled Systems - Advance</td>
<td>Geimer</td>
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#### Competence Certificate

Preparation of semester report

#### Prerequisites

none
# Course: Solar Thermal Energy Systems [T-MACH-106493]

**Responsible:** apl. Prof. Dr. Ron Dagan  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology

<table>
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**Events**

| WT 23/24 | 2189400 | Solar Thermal Energy Systems | 2 SWS | Lecture / Dagan |

**Exams**

| WT 23/24 | 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:**

**Lecture (V)**

|-----------------------------|-------------------------------------------------------------|
Content
The course deals with fundamental aspects of solar energy
1. Introduction to solar energy – global energy panorama
2. Solar energy resource-
   Structure of the sun, Black body radiation, solar constant, solar spectral distribution
   Sun-Earth geometrical relationship
3. Passive and active solar thermal applications.
4. Solar thermal systems- solar collector-types, concentrating collectors, solar towers,
   Heat losses, efficiency
5. Selected topics on thermodynamics and heat transfer which are relevant for solar systems.
6. Introduction to Solar induced systems: Wind , Heat pumps, Biomass , Photovoltaic
7. Energy storage
   The course deals with fundamental aspects of solar energy. Starting from a global energy panorama the course deals with the sun as a thermal energy source. In this context, basic issues such as the sun's structure, blackbody radiation and solar–earth geometrical relationship are discussed. In the next part, the lectures cover passive and active thermal applications and review various solar collector types including concentrating collectors and solar towers and the concept of solar tracking. Further, the collector design parameters determination is elaborated, leading to improved efficiency. This topic is augmented by a review of the main laws of thermodynamics and relevant heat transfer mechanisms.
   The course ends with an overview on energy storage concepts which enhance practically the benefits of solar thermal energy systems.
   The students get familiar with the global energy demand and the role of renewable energies learn about improved designs for using efficiently the potential of solar energy gain basic understanding of the main thermal hydraulic phenomena which support the work on future innovative applications will be able to evaluate quantitatively various aspects of the thermal solar systems.
Total 120 h, hereof 30 h contact hours and 90 h homework and self-studies
oral exam about 30 min.

Organizational issues
Die Veranstaltung wird nur online gehalten, falls durch Corona Einschränkungen vorgegeben werden.

Literature
- "Fundamentals of classical Thermodynamics", G. Van Wylen & R. E. Sonntag. Published by Wiley & Sons
8.223 Course: Specialisation Module - Self Assignment BeNe [T-ZAK-112346]

- **Responsible:** Christine Myglas
- **Organisation:** Part of: M-ZAK-106099 - Supplementary Studies on Sustainable Development

**Type**
- Examination of another type

**Credits**
- 6

**Grading scale**
- Grade to a third

**Version**
- 1

**Competition Certificate**
The monitoring occurs in the form of several supplementary courses, which usually comprise a presentation of the (group) project, a written elaboration of the (group) project as well as an individual term paper, if necessary with appendices (examination performances of other kind according to statutes § 5 section 3 No. 3 or § 7 section 7).
The presentation is usually with the accompanying practice partners, as well as the written paper.

**Prerequisites**
Active participation in all three mandatory components.

**Self service assignment of supplementary studies**
This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Recommendation**
Knowledge from 'Basic Module' and 'Elective Module' is helpful.
Responsible: Bernd Grube
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102576 - Key Competences

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**Events**

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<td>Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example</td>
<td>Seminar / Grube</td>
<td>2 SWS</td>
<td>pass/fail</td>
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**Exams**

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<td>Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example</td>
<td>Seminar / Grube</td>
<td>Bernd Grube</td>
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</table>

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

**Comptence 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 23/24, 2 SWS, Language: German, Open in study portal
Content
The lecture series provides an insight into the main functional areas of a global company and is based on close interaction with the students. Top managers from Bosch explain the technical and business processes of a company using examples from their business areas. The tasks of the engineer working at an innovative and globally active automotive supplier is addressed. These range from technical competence and an understanding of economic aspects to questions of personnel responsibility.

In addition, insights are provided into the careers of the Bosch managers giving the lectures. The focus of the course is therefore not only on business processes but also on first-hand accounts of challenges, successes, failures and product and process innovations.

The topics in detail are:

- Introduction, Strategy, Innovation
- R&D, Product Development Process
- Production
- Quality Assurance
- Market, Marketing, Sales
- Aftermarket, Service
- Finance, Controlling
- Logistics
- Purchasing, Supply Chain
- IT
- HR, Leadership, Compliance

Learning Outcomes:
The students ...

- are able to deduce, understand and assess the structure of a global operating enterprise.
- are capable to identify and compare the work flows and processes within a global operating enterprise.
- are able to recognize and assess the problems within interfaces between functional and organizational units which are identified by the experts. Furthermore the students can develop solutions based on this knowledge in order to overcome these problems.

Workload:
regular attendance: 21 hours
self-study: 39 hours

Organizational issues
Die Anmeldung zum Seminar erfolgt über Ilias. ([https://ilias.studium.kit.edu/](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/](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/](https://ilias.studium.kit.edu)) bereitgestellt.

Lecture notes will be provided in Ilias ([https://ilias.studium.kit.edu/](https://ilias.studium.kit.edu)).
8.225 Course: Strategic Product Development - Identification of Potentials of Innovative Products [T-MACH-105696]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102812 - Major Field: Powertrain Systems  
M-MACH-102815 - Major Field: Engineering Design  
M-MACH-102818 - Major Field: Vehicle Technology

<table>
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**Exams**

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**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**

<table>
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<th>Recurrence</th>
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</table>

**Content**

Introduction into future management, Development of scenarios, scenariobased strategy development, trendmanagement, strategic early detection, innovation- and technologymanagement, scenarios in product development, from profiles of requirements to new products, examples out of industrial praxis.

**Organizational issues**

Anmeldung erforderlich; Termine/ Ort und weitere Informationen siehe IPEK-Homepage
### 8.226 Course: Strategic Product Development - Identification of Potentials of Innovative Products - Case Study [T-MACH-110396]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102812 - Major Field: Powertrain Systems  
M-MACH-102815 - Major Field: Engineering Design  
M-MACH-102818 - Major Field: Vehicle Technology

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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:**

### Strategic product development - identification of potentials of innovative products

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

**Content**
Introduction into future management, Development of scenarios, scenariobased strategy development, trendmanagement, strategic early detection, innovation- and technologymanagement, scenarios in product development, from profiles of requirements to new products, examples out of industrial praxis.

**Organizational issues**
Anmeldung erforderlich; Termine/ Ort und weitere Informationen siehe IPEK-Homepage
8.227 Course: Structural Analysis of Composite Laminates [T-MACH-105970]

Responsible: Prof. Dr.-Ing. Luise Kärger
Organisation: KIT Department of Mechanical Engineering
Lightweight Design
Part of: M-MACH-102746 - Compulsory Elective Module
M-MACH-102819 - Major Field: Materials Science and Engineering

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Events

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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:

**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
8.228 Course: Sustainable Product Engineering [T-MACH-105358]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102583 - Major Field: Information Management  
M-MACH-102812 - Major Field: Powertrain Systems  
M-MACH-102815 - Major Field: Engineering Design  
M-MACH-102818 - Major Field: Vehicle Technology  
M-MACH-102820 - Major Field: Mechatronics

**Type**  
Written examination

**Credits**  
4

**Grading scale**  
Grade to a third

**Recurrence**  
Each summer term

**Version**  
2

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</table>

**Competence Certificate**  
written exam (90 min)

**Prerequisites**  
none

**Recommendation**  
None

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

**Sustainable Product Engineering**  
2146192, SS 2024, 2 SWS, [Open in study portal]

**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 and 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.
8.229 Course: Sustainable Production Economics [T-MACH-111859]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-105902 - Sustainable Production Economics

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

**Competence Certificate**

written exam (duration: 90 min)

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-100304 - Production Operations Management must not have been started.
2. The course T-MACH-108734 - Production Operations Management-Project must not have been started.

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

**Sustainable Production Economics**

2149616, WS 23/24, 4 SWS, Language: German, Open in study portal

**Content**

The lecture conveys an overall understanding of operational production management with special consideration of aspects of sustainability as well as an application-oriented understanding of the fundamental issues and methods in industrial companies. Through exercises as well as a business game synchronous to the lecture, the taught contents are deepened through application, so that the participants can apply them directly in their later professional environment.

**Learning Outcomes:**

After successful completion of the course, the students are able …

- to discuss, alone and in a team, the terms, contexts and models by which manufacturing companies are described;
- to discuss typical problems of manufacturing companies, especially against the background of current and future challenges of ecological, social and economic sustainability;
- to apply the most important methods for efficient and sustainable management in industrial enterprises, in particular in the sense of the circular economy, in a problem-related manner;
- to select and justify decision-making alternatives by applying the methods learned;
- to critically question the methods learned and to independently acquire methods that go beyond this.

**Workload:**

regular attendance: 42 hours  
self-study: 108 hours

**Organizational issues**

Vorlesungstermine montags, Übungstermine freitags.  
Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung.
Literatur

Medien:
Skrift zur Veranstaltung wird über ilias (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
Lecture notes will be provided in ilias (https://ilias.studium.kit.edu/).
**8.230 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-102645 - Major Field: Combustion Engine Techniques  
M-MACH-102818 - Major Field: Vehicle Technology  
M-MACH-102838 - Major Field: Energy Converting Engines

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

**Competence Certificate**

oral exam (approx. 20 minutes)

**Prerequisites**

none

**Annotation**

Starting in winter term 25/26, the course consists of a lecture (2h / week) and a tutorial (1 h / week).

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

**Sustainable Vehicle Drivetrains**

2133132, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Content**

Sustainability  
Environmental balance  
Legislation  
Alternative fuels  
BEV  
Fuel cell  
Hybrid drives
8.231 Course: System Integration in Micro- and Nanotechnology [T-MACH-105555]

**Responsible:** apl. Prof. Dr. Ulrich Gengenbach

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102820 - Major Field: Mechatronics

**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

**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 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

On-Site

**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
**8.232 Course: System Integration in Micro- and Nanotechnology 2 [T-MACH-110272]**

**Responsible:** apl. Prof. Dr. Ulrich Gengenbach  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102820 - Major Field: Mechatronics

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

**Competence Certificate**

Oral exam, approx. 15 min.

**Prerequisites**

None

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

**System Integration in Micro- and Nanotechnology 2**

2105040, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Content**

Introduction to system integration (novel processes and applications)  
Assembly of hybrid microsystems  
Packaging processes  
Applications:

- Lab-on-chip systems  
- Microoptical systems  
- Silicon Photonics

Novel integration processes:

- Direct Laser Writing  
- Self Assembly

**Learning objectives**

The students acquire knowledge of novel system integration technologies and their application in microoptic and microfluidic systems.

**Literature**

N.-T. Nguyen, Fundamentals and Applications of Microfluidics, Artech House  
G. T. Reed, Silicon Photonics: An Introduction, Wiley

Bachelor's Program Mechanical Engineering (B.Sc.), Date: 23/02/2024  
Module Handbook, valid from Summer Term 2024
8.233 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-102746 - Compulsory Elective Module

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

Competence Certificate
The assessment is carried out as a written exam of 2 h.

Prerequisites
M-MACH-102562 - Materials Science must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-MACH-102562 - Materials Science must have been passed.

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 2024, 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
Institute of Thermal Turbomachinery

Part of: M-MACH-102815 - Major Field: Engineering Design
M-MACH-102816 - Major Field: Fundamentals of Energy Technology

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

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<td>Technical Acoustics</td>
<td>Pantle, Walter</td>
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Competence Certificate
oral exam, 30 min.

Prerequisites
None

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

Technical Acoustics
2158107, SS 2024, 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.

Organizational issues
Literature
1. Vorlesungsskript (über ILIAS erreichbar).
8.235 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-102815 - Major Field: Engineering Design

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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 2024, 2 SWS, Language: German, Open in study portal

**Content**

Introduction  
Relevant parameters on product value in Technical Design  
Design in Methodical Development and Engineering and for a differentiated validation of products  
Design in the concept stage of Product Development  
Design in the draft and elaboration stage of Product Development  
Best Practice

After listening to 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**

Die Veranstaltung findet 2024 nicht statt.
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
8.236 Course: Technical Thermodynamics and Heat Transfer I [T-MACH-104747]

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

**Part of:** M-MACH-102574 - Technical Thermodynamics

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<td>Lecture / On-Site</td>
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**Exams**

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

**Competence Certificate**

Written exam, approx. 3 hours

**Prerequisites**

Successful participation in the tutorial (T-MACH-105204 - Exercices in Technical Thermodynamics and Heat Transfer I)

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-105204 - Exercices in Technical Thermodynamics and Heat Transfer I must have been passed.

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

<table>
<thead>
<tr>
<th>Lecture (V)</th>
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<tbody>
<tr>
<td>On-Site</td>
</tr>
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</table>

**Technical Thermodynamics and Heat Transfer I**

2165501, WS 23/24, 4 SWS, Language: German, [Open in study portal](#)

**Content**

- System, properties of state
- Absolute temperature, model systems
- 1st law of thermodynamics for resting and moving systems
- Entropy and 2nd law of thermodynamics
- Behavior of real substances described by tables, diagrams and equations of state
- Machine processes
- Mixtures of ideal and real compounds

**Literature**

Vorlesungsskriptum


Technical Thermodynamics and Heat Transfer I
3165014, WS 23/24, 4 SWS, Language: English, Open in study portal

Content

- System, properties of state
- Absolute temperature, model systems
- 1st law of thermodynamics for resting and moving systems
- Entropy and 2nd law of thermodynamics
- Behavior of real substances described by tables, diagrams and equations of state
- Machine processes
- Mixtures of ideal and real compounds

Literature

Vorlesungsskriptum

8.237 Course: Technical Thermodynamics and Heat Transfer II [T-MACH-105287]

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

**Part of:** M-MACH-102574 - Technical Thermodynamics

<table>
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**Exams**

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<td>Technical Thermodynamics and Heat Transfer II</td>
<td>4</td>
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</table>

**Competence Certificate**

Written exam, approx. 3 hours

**Prerequisites**

Successful participation in the tutorial (T-MACH-105288 - Exercises in Technical Thermodynamics and Heat Transfer II)

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-105288 - Exercises in Technical Thermodynamics and Heat Transfer II must have been passed.

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

### Technical Thermodynamics and Heat Transfer II

2166526, SS 2024, 4 SWS, Language: German, [Open in study portal](#)

**Lecture (V) On-Site**

**Content**

- Repetition of the topics of "Thermodynamics and Heat Transfer I"
- Behavior of mixtures
- Moist air
- Kinetic theory of gases
- Behavior of real substances described by equations of state
- Chemical reactions and applications of the laws of thermodynamics to chemical reactions
- Reaction kinetics
- Heat Transfer

**Literature**

Vorlesungsskriptum


Course: Technology of Steel Components [T-MACH-105362]

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

Part of: M-MACH-102819 - Major Field: Materials Science and Engineering

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

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
M-MACH-102562 - Materials Science must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-MACH-102562 - Materials Science must have been passed.

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

Content
Meaning, Development and characterization of component states
Description of the influence of component state on mechanical properties
Stability of component states
Steel manufacturing
Component states due to forming
Component states due to heat treatments
Component states due to surface hardening
Component states due to machining
Component states due to mechanical surface treatments
Component states due to joining
Summarizing evaluation

learning objectives:
The students have the background to evaluate the influence of manufacture processes on the compound state of metallic compounds. The students can assess the influence and the stability of compound state under mechanical load. The students are capable to describe the individual aspects of interaction of the compound state of steel components due to forming, heat treatment, mechanical surface treatment and joining processes.

requirements:
Materials Science and Engineering I & II

workload:
regular attendance: 21 hours
self-study: 99 hours
Literature
Skript wird in der Vorlesung ausgegeben

VDEh: Werkstoffkunde Stahl, Bd. 1: Grundlagen, Springer-Verlag, 1984


V. Schulze: Modern Mechanical Surface Treatments, Wiley, Weinheim, 2005
8.239 Course: Theory of Stability [T-MACH-105372]

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

Part of:
- M-MACH-102820 - Major Field: Mechatronics
- M-MACH-104442 - Major Field: Vibration Theory

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

| ST 2024 | 2163113 | Theory of Stability | 2 SWS | Lecture / ✗ | Fidlin |
| ST 2024 | 2163114 | Übungen zu Stabilitätstheorie | 2 SWS | Practice / ✗ | Fidlin, Yüzbasioglu |

Exams

| WT 23/24 | 76-T-MACH-105372 | Theory of Stability | Fidlin |

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

Theory of Stability
2163113, SS 2024, 2 SWS, Language: German, Open in study portal

Content
- Basic concepts of stability
- Lyapunov's functions
- Direct Lyapunov's methods
- Stability of equilibria positions
- Attraction area of a stable solution
- Stability according to the first order approximation
- Systems with parametric excitation
- Stability criteria in the control theory

Organizational issues
Die Vorlesung Stabilitätstheorie wird im Sommersemester 2024 nicht angeboten.

Literature
Course: Thermal Solar Energy [T-MACH-105225]

责任人: N.N.
组织机构: KIT Department of Mechanical Engineering

部分: M-MACH-102816 - Major Field: Fundamentals of Energy Technology

**课程信息**

<table>
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<th>类型</th>
<th>得分</th>
<th>评分等级</th>
<th>期末考试</th>
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**事件**

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<td>2 SWS</td>
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<td>Thermal Solar Energy</td>
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<td>Lecture (V) On-Site</td>
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**课程手册**

- 等级: 2169472, WS 23/24, 2 SWS, Language: German, Open in study portal
- 设计: 2169472, WS 23/24, 2 SWS, Language: German, Open in study portal
- 版本: 1

**所需考试时间**

- 口头考试: 30分钟

**先决条件**

- 无

**摘录**

- 你会找到与本课程相关的部分

**内容**

- 特点:
  1. 入门到能量要求及评估热能学的潜在使用
  2. 太阳能热能学: 太阳,太阳能常数,辐射 (直接,散射,吸收,入射角,辐射平衡).
  3. 太阳能集热器: 集热器的结构,效率的基本原则,集中度及它们的局限性.
  4. 太阳能热能学: 在固体和气体中,辐射热传输在透明和不透明的体系,选择性吸收器 - 典型材料及制造过程.
  5. 模型及热传输: 基于单向和多相传输的基本方程,计算方法,稳定性限制.
- 选修
  7. 高温热能学系统: 太阳塔及太阳能热能学概念,损失机制,烟囱热能学及生产过程.

**建议 / 前知识**

- 基础热能学和热力学,材料科学及流体力学,热能学在光学及热动力学中是可靠的知识.
- 口头考试约25分钟,不需工具或参考材料可能用于考试.
Organizational issues
Die Veranstaltung wird nur online gehalten, falls durch Corona Einschränkungen vorgegeben werden.

Literature
Bereitstellung des Studienmaterials in gedruckter und elektronischer Form.
# 8.241 Course: Thermal Turbomachines I [T-MACH-105363]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering  
Institute of Thermal Turbomachinery  
**Part of:** M-MACH-102838 - Major Field: Energy Converting Engines

<table>
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**Events**

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<td>3 SWS</td>
<td>Bauer</td>
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<td>Lecture / 🗣️</td>
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<td><strong>WT 23/24</strong></td>
<td>2169454</td>
<td>Tutorial - Thermal Turbo</td>
<td>2 SWS</td>
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**Exams**

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<td>Bauer</td>
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<td>Thermal Turbomachines I</td>
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<td>Thermal Turbomachines I for repeater</td>
<td>Bauer</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:**

**Thermal Turbomachines I**

2169453, WS 23/24, 3 SWS, Language: English, [Open in study portal](#)
Content
Basic concepts of thermal turbomachinery
Steam Turbines - Thermodynamic process analysis
Gas Turbines - Thermodynamic process analysis
Combined cycle and cogeneration processes
Overview of turbomachinery theory and kinematics
Energy transfer process within a turbine stage
Types of turbines (presented through examples)
1-D streamline analysis techniques
3-D flow fields and radial momentum equilibrium in turbines
Compressor stage analysis and future trends in turbomachinery

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 wird nur noch in Englisch gehalten ab WS 2023/24.
Aufzeichnungen in Deutsch aus früheren Vorlesungen werden weiter zur Verfügung gestellt.

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

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

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering
               Institute of Thermal Turbomachinery
Part of: M-MACH-102838 - Major Field: Energy Converting Engines

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

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<td>Thermal Turbomachines II (in English)</td>
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Exams

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<td>Thermal Turbomachines II (for repeaters)</td>
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</table>

Competence Certificate
oral exam, duration: 30 min.

Prerequisites
none

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

Thermal Turbomachines II (in English)
2170553, SS 2024, 3 SWS, Language: English, Open in study portal

Lecture (V)
On-Site
Content
Basic concepts of thermal turbomachinery
Steam Turbines - Thermodynamic process analysis
Gas Turbines - Thermodynamic process analysis
Combined cycle and cogeneration processes
Overview of turbomachinery theory and kinematics
Energy transfer process within a turbine stage
Types of turbines (presented through examples)
1-D streamline analysis techniques
3-D flow fields and radial momentum equilibrium in turbines
Compressor stage analysis and future trends in turbomachinery

Recommendations:
Recommended in combination with the lecture 'Thermal Turbomachines 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
Course: Tires and Wheel Development for Passenger Cars [T-MACH-102207]

**Responsible:** Prof. Dr.-Ing. Günter Leister

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102818 - Major Field: Vehicle Technology

<table>
<thead>
<tr>
<th>Type</th>
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<th>Recurrence</th>
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<td>Grade to a third</td>
<td>Each summer term</td>
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**Events**

| ST 2024 | 2114845 | Tires and Wheel Development for Passenger Cars | 2 SWS | Lecture / 🗣 | Leister |

**Exams**

| WT 23/24 | 76-T-MACH-102207 | Tires and Wheel Development for Passenger Cars | Leister |

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

**Competence Certificate**

Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

**Prerequisites**

none

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

**Tires and Wheel Development for Passenger Cars**

2114845, SS 2024, 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 incuding 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
Course: Tools for HPC and AI in Engineering [T-MACH-113265]

**Responsible:** Dr.-Ing. Samuel Braun  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102645 - Major Field: Combustion Engine Techniques

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**Events**

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<td>Tools for HPC and AI in Engineering</td>
<td>2 SWS</td>
<td>Lecture / Braun</td>
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**Competence Certificate**
oral exam, 20 min.

**Prerequisites**
none

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

**Tools for HPC and AI in Engineering**
2133120, WS 23/24, 2 SWS, Language: German, [Open in study portal]
Content
The lecture covers the basics of the tools necessary to work in the fields of artificial intelligence and high performance computing.

In particular, the framework conditions and the infrastructure provided by KIT will also be addressed. The following topics and issues will be covered:

- **Hardware and operating system**
  Which (relevant) components does a computer have? How can AI applications be executed with different operating systems (Windows, MacOS, Linux)? How can supercomputers be accessed from different operating systems?

- **Command line**
  What is the command line and why does it (still) exist? What possibilities do the different operating systems offer to access the command line? Which shells exist and which are typical on HPC facilities? What are the basic commands to get around on a supercomputer?

- **Remote Access**
  How to access a supercomputer, what are the types of authentication? How do you set up SSH keys and what forms of 2-factor authentication are common? How does a file transfer between supercomputer and local computer work?

- **Supercomputers and HPC**
  How is a supercomputer different from regular PCs? Which HPC resources does KIT offer? How are they accessed and what are the special features of the KIT infrastructure compared to other systems? What infrastructure is available statewide and nationally, for what purposes? How must software be designed to be compatible with supercomputers?

- **Version Control**
  What is it and why is it needed? What code hosting services exist? How does one access the Gitlab instance operated by KIT? What CI/CD capabilities exist at KIT?

- **Editors**
  How to edit program code, locally or remotely? What are the possibilities of Visual Studio Code to debug AI applications or HPC workflows on KIT supercomputers? How to develop code with code-server on compute nodes? How can documentation be done? What is the current state of pair programming with AI?

- **Python and Jupyter**
  Which Python distributions exist? Which ones are suitable for KIT HPC resources? How can Python packages be installed and used? What are Virtual Environments and what are they needed for? How can machine learning applications be developed with Jupyter, locally and remotely?

- **Machine Learning**
  What are the typical software packages needed for AI applications? How are they installed and used? What is a typical workflow to develop/use ML applications? What are accelerators, what specialized hardware does KIT infrastructure have?

- **Remote Visualization**
  How to use graphical applications on remote computers? What are the possibilities of remote visualization? Using Paraview as an example, how can a flow simulation be graphically evaluated interactively/non-interactively?

- **Special topics**
  What are containers and virtual machines? What are the benefits of containers especially for Machine Learning applications? Which container solutions can be used on KIT supercomputers? What is WSL 2? Which (commercial) cloud services exist for HPC and AI? Which cloud services are available at KIT for free?

Learning objectives
A major learning goal of the lecture is to provide an overview of available and suitable software tools (editors, access options, version management, infrastructure (at KIT)) for HPC and AI. Any existing fear of contact with the Linux operating system and the seemingly complex use of supercomputers will be eliminated. After successful attendance of the lecture, the students will be able to work on theses that touch on the topics of Artificial Intelligence or High Performance Computing.

Performance assessment
Oral exam: 30 min
8.245 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-102812 - Major Field: Powertrain Systems

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**Events**

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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:**

**V Tribology**
2181114, WS 23/24, 5 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
On-Site
Content

- **Chapter 1: Friction**
  adhesion, geometrical and real area of contact, Friction experiments, friction powder, tribological stressing, environmental influences, tribological age, contact models, Simulation of contacts, roughness.

- **Chapter 2: Wear**
  plastic deformation at the asperity level, dissipation modes, mechanical mixing, Dynamics of the third body, running-in, running-in dynamics, shear stress.

- **Chapter 3: Lubrication**
  base oils, Striebeck plot, lubrication regimes (HD, EHD, mixed lubrication), additives, oil characterization, solid lubrication.

- **Chapter 4: Measurement Techniques**
  friction measurement, tribometer, dissipated frictional power, conventional wear measurement, continuous wear measurement(RNT)

- **Chapter 5: Roughness**
  profilometry, surface roughness parameters, evaluation length and filters, bearing ratio curve, measurement error

- **Chapter 6: Accompanying Analysis**
  multi-scale topography measurement, chemical surface analysis, structural analysis, mechanical analysis

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

The student can

- describe the fundamental friction and wear mechanisms, which occur in tribologically stressed systems
- evaluate the friction and wear behavior of tribological systems
- explain the effects of lubricants and their most important additives
- identify suitable approaches to optimize tribological systems
- explain the most important experimental methods for the measurement of friction and wear, and is able to use them for the characterisation of tribo pairs
- choose suitable methods for the evaluation of roughness and topography from the nm-scale to the mm-scale and is able to interpret the determined values in respect to their effect on the tribological behavior
- describe the most important surface-analytical methods and their physical principles for the characterization of tribologically stressed sliding surfaces

preliminary knowledge in mathematics, mechanics and materials science recommended

regular attendance: 45 hours
self-study: 195 hours
oral examination (ca. 40 min)
no tools or reference materials
admission to the exam only with successful completion of the exercises

Literature

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-102645 - Major Field: Combustion Engine Techniques
- M-MACH-102838 - Major Field: Energy Converting Engines

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**Events**

| WT 23/24  | 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
8.247 Course: Turbo Jet Engines [T-MACH-105366]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
Part of: M-MACH-102838 - Major Field: Energy Converting Engines

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

Competence Certificate
oral exam, duration: 20 min.

Prerequisites
none

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

Turbo Jet Engines
2170478, SS 2024, 2 SWS, Language: German, Open in study portal

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
8.248 Course: Tutorial Advanced Mathematics I [T-MATH-100525]

**Responsible:** PD Dr. Tilo Arens  
Prof. Dr. Roland Griesmaier  
PD Dr. Frank Hettlich

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102859 - Advanced Mathematics

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**Competence Certificate**

Learning assessment is carried out by written assignments (pre-requisite). Exact requirements will be communicated in the lectures.

**Prerequisites**

None.
### 8.249 Course: Tutorial Advanced Mathematics II [T-MATH-100526]

**Responsible:**  
PD Dr. Tilo Arens  
Prof. Dr. Roland Griesmaier  
PD Dr. Frank Hettlich  

**Organisation:**  
KIT Department of Mathematics  

**Part of:**  
M-MATH-102859 - Advanced Mathematics  

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<td>pass/fail</td>
<td>Each summer term</td>
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**Competence Certificate**  
Learning assessment is carried out by written assignments (pre-requisites). Exact requirements will be communicated in the lectures.

**Prerequisites**  
None.
### 8.250 Course: Tutorial Advanced Mathematics III [T-MATH-100527]

**Responsible:**
- PD Dr. Tilo Arens
- Prof. Dr. Roland Griesmaier
- PD Dr. Frank Hettlich

**Organisation:**
KIT Department of Mathematics

**Part of:**
M-MATH-102859 - Advanced Mathematics

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**Competence Certificate**

Learning assessment is carried out by written assignments (pre-requisite). Exact requirements will be communicated in the lectures.

**Prerequisites**
None.
8.251 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-102582 - Major Field: Continuum Mechanics
- M-MACH-102746 - Compulsory Elective Module

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**Exams**

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</table>

**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 students from different fields 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

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**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".
8.252 Course: Tutorial Engineering Mechanics I [T-MACH-100528]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Dr.-Ing. Tom-Alexander Langhoff

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102572 - Engineering Mechanics

<table>
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Exams

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<td>76-T-MACH-100528-englisch</td>
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Legend: 🖥 Online, 🧱 Blended (On-Site/Online), 🗣 On-Site, ⚪ Cancelled

Competence Certificate
Successful solution of worksheets. Details are given in the first lecture "Engineering Mechanics I"

Passing this course allows to register to the exam "Engineering Mechanics I" (see T-MACH-100282).

Prerequisites
None

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

**Tutorial Engineering Mechanics I**

2161246, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Engineering Mechanics I (Tutorial)**

3161011, WS 23/24, 2 SWS, Language: English, [Open in study portal](#)

Content
Please refer to the lecture Engineering Mechanics I.

Literature
Siehe Vorlesung Technische Mechanik I

**Tutorial Engineering Mechanics I**

2161246, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

Practice (Ü) On-Site

Content
See Lecture "Engineering Mechanics I"

Literature
See Lecture "Engineering Mechanics I"

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Dr.-Ing. Tom-Alexander Langhoff

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102572 - Engineering Mechanics

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Events

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<td>2 SWS</td>
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<td>ST 2024</td>
<td>Engineering Mechanics II (Tutorial)</td>
<td>2 SWS</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

Competence Certificate
Successful solution of worksheets. Details are given in the first lecture "Engineering Mechanics II"
Passing this course allows to register to the exam "Engineering Mechanics II" (see T-MACH-100283).

Prerequisites
None

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

V  Tutorial Engineering Mechanics II
2162251, SS 2024, 2 SWS, Language: German, Open in study portal

Content
see lecture Engineering Mechanics II

Literature
Siehe Vorlesung Technische Mechanik II

V  Engineering Mechanics II (Tutorial)
3162011, SS 2024, 2 SWS, Language: English, Open in study portal

Content
see lecture "Engineering Mechanics II"

Literature
see lecture "Engineering Mechanics II"
Course: Tutorial Engineering Mechanics III [T-MACH-105202]

**Responsible:** N.N.

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102572 - Engineering Mechanics

### Type
- Completed coursework (written)

### Credits
- 0

### Grading scale
- pass/fail

### Recurrence
- Each winter term

### Version
- 2

#### Events

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<td>Practice / On-Site</td>
<td>Proppe, Altoé, Fischer, Römer</td>
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<td>Engineering Mechanics III (Tutorial)</td>
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#### Exams

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<th>Module</th>
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<td>Tutorial Engineering Mechanics III</td>
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</table>

**Competence Certificate**
- Attestations, successful accomplishment of exercise sheets

**Prerequisites**
- None

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

#### Content

In the Tutorial exercises for the corresponding subjects of the lecture are presented. During the tutorial part of the tutorial exercises are presented and instructions for those exercises are given which have to be done as homework.

The homework is mandatory and is corrected by the tutors. A successful elaboration of the homework is necessary to take part in the final exam.

#### Literature

- Hibbeler: Technische Mechanik 3, Dynamik, München, 2006
- Gross, Hauger, Schnell: Technische Mechanik Bd. 3, Heidelberg, 1983
- Lehmann: Elemente der Mechanik III, Kinetik, Braunschweig, 1975
- Göldner, Holzweissig: Leitfaden der Technischen Mechanik.
- Hagedorn: Technische Mechanik III.

#### Content

Exercises related to the lecture
Course: Tutorial Engineering Mechanics IV [T-MACH-105203]

**Responsible:** N.N.

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102572 - Engineering Mechanics

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### Events

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

**Competence Certificate**

Attestations, successful accomplishment of exercise sheets

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

**Engineering Mechanics IV (Tutorial)**

2162232, SS 2024, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**

**On-Site**

**Content**

In the Tutorial exercises for the corresponding subjects of the lecture are presented. During the tutorial part of the exercises are presented and instructions are given for those exercises which have to be done as homework.

The homework is mandatory and is corrected by the tutors. A successful elaboration of the homework is necessary to take part in the final exam.

**Literature**

Hibbeler: Technische Mechanik 3, Dynamik, München, 2006

Marguerre: Technische Mechanik III, Heidelberger Taschenbücher, 1968

Magnus: Kreisel, Theorie und Anwendung, Springer-Verlag, Berlin, 1971

Klotter: Technische Schwingungslehre, 1. Bd. Teil A, Heidelberg
8.256 Course: Tutorial Introduction to Computational Fluid Dynamics [T-MACH-111033]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-102582 - Major Field: Continuum Mechanics  
M-MACH-102746 - Compulsory Elective Module

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**Exams**

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**Competence Certificate**

The competence certificate consists of successfully solving the computational homework tasks.

**Prerequisites**

none

**Annotation**

Successful participation in this course allows for registration to the Exam: "Introduction to Computational Fluid Dynamics" (see T-MACH-110362).

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 is expected.

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

**Tutorial Introduction to Computational Fluid Dynamics**

2154534, SS 2024, 2 SWS, Language: German, Open in study portal  
Practice (Ü)  
Blended (On-Site/Online)

**Content**

- Introduction and Motivation, Fundamental Equations and Dimensionless Numbers
- Turbulence and Modelling (DNS, LES, RANS);
- Numerical Solution of the Navier Stokes Equations: Discretization and Solution Approaches (FDM, FVM), boundary and initial conditions, stability, mistakes in numerics and modelling
- Set-up of a numerical simulation: pre- and postprocessing, validation, result evaluation, discussion of results
- Introduction to open-source toolbox OpenFOAM: set-up of simulation, generation of numerical grid with different tools, data evaluation within OpenFOAM and with python;
- Introduction to a research oriented toolbox for turbulent flows (DNS based o Incompact3d): set-up of simulation, statistical evaluation and analysis with MATLAB und python;
- visualization of simulation results in ParaView

This course includes a lecture and a computer course. The limited places in the computer course will be distributed by the institute.
8.257 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-102582 - Major Field: Continuum Mechanics
- M-MACH-102746 - Compulsory Elective Module

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**Events**

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<td>Each summer term</td>
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**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 2024, 1 SWS, Language: German, Open in study portal

**Practice (Ü)**

On-Site

**Content**

See lecture "Introduction to the Finite Element Method"

**Literature**

siehe Vorlesung "Einführung in die Finite-Elemente-Methode"
8.258 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-102746 - Compulsory Elective Module

Events

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Events

| WT 23/24   | 2161255 | Tutorial Mathematical Methods in Continuum Mechanics | 2 SWS | Practice / 🗣️ | Lauff, Sterr, Böhlke |

Exams

| WT 23/24   | 76-T-MACH-110376 | Tutorial Mathematical Methods in Continuum Mechanics | Böhlke |

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

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:

Tutorial Mathematical Methods in Continuum Mechanics

2161255, WS 23/24, 2 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

Content

See "Mathematical Methods in Continuum Mechanics"

Literature

Siehe "Mathematische Methoden der Kontinuumsmechanik"
8.259 Course: Vehicle Comfort and Acoustics I [T-MACH-105154]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-102818 - Major Field: Vehicle Technology
- M-MACH-104442 - Major Field: Vibration Theory

<table>
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**Events**

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<td>Lecture / 🗣 Gauterin</td>
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**Exams**

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<td>Oral Examination</td>
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**Competence Certificate**

Oral Examination

Duration: approx. 30 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 Comfort and Acoustics I**

2113806, WS 23/24, 2 SWS, Language: German, Open in study portal

**Content**

1. Perception of noise and vibrations
2. Fundamentals of acoustics and vibrations
3. Tools and methods for measurement, computing, simulation and analysis of noise and vibrations
4. The relevance of tire and chassis for the acoustic and mechanical driving comfort: phenomena, influencing parameters, types of construction, optimization of components and systems, conflict of goals, methods of development

An excursion will give insights in the development practice of a car manufacturer or a system supplier.

**Learning Objectives**

The students know what noises and vibrations mean, how they are generated, and how they are perceived by human beings.

They have knowledge about the requirements given by users and the public. They know which components of the vehicle are participating in which way on noise and vibration phenomenon and how they could be improved. They are ready to apply different tools and methods to analyze relations and to judge them. They are able to develop the chassis regarding driving comfort and acoustic under consideration of goal conflicts.

**Organizational issues**

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

Kann nicht mit der Veranstaltung [2114856] kombiniert werden.

Can not be combined with lecture [2114856]
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
the lectures are available as a video stream.
You will find the lecture material and the videos on ILIAS. To get the ILIAS password, refer to https://fast-web-01.fast.kit.edu/Passwoerterilias/
Kann nicht mit der Veranstaltung [2113806] kombiniert werden.
Can not be combined with lecture [2113806]

Literature
2. Russel C. Hibbeler, Technische Mechanik 3, Dynamik, Pearson Studium, München, 2006

Das Skript wird zu jeder Vorlesung zur Verfügung gestellt
**8.260 Course: Vehicle Comfort and Acoustics II [T-MACH-105155]**

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

**Part of:**  
M-MACH-102818 - Major Field: Vehicle Technology  
M-MACH-104442 - Major Field: Vibration Theory

<table>
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**Events**

| ST 2024 | 2114825 | Vehicle Comfort and Acoustics II | 2 SWS | Lecture / Online | Gauterin |
| ST 2024 | 2114857 | Vehicle Ride Comfort & Acoustics II | 2 SWS | Lecture / Online | Gauterin |

**Exams**

| WT 23/24 | 76-T-MACH-105155 | Vehicle Comfort and Acoustics II | Gauterin |

**Competence Certificate**

Oral Examination  
Duration: approx. 30 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 2024, 2 SWS, Language: German, Open in study portal

Lecture (V)  
Online
Content
1. Summary of the fundamentals of acoustics and vibrations

2. The relevance of road surface, wheel imperfections, springs, dampers, brakes, bearings and bushings, suspensions, engines and drive train for the acoustic and mechanical driving comfort:
   - phenomena
   - influencing parameters
   - types of construction
   - optimization of components and systems
   - conflicts of goals
   - methods of development

3. Noise emission of motor vehicles
   - noise stress
   - sound sources and influencing parameters
   - legal restraints
   - optimization of components and systems
   - conflict of goals
   - methods of development

Learning Objectives:
The students have knowledge about the noise and vibration properties of the chassis components and the drive train. They know what kind of noise and vibration phenomena do exist, what are the generation mechanisms behind, which components of the vehicle participate in which way and how could they be improved. They have knowledge in the subject area of noise emission of automobiles: Noise impact, legal requirements, sources and influencing parameters, component and system optimization, target conflicts and development methods. They are ready to analyze, to judge and to optimize the vehicle with its single components regarding acoustic and vibration phenomena. They are also able to contribute competently to the development of a vehicle regarding the noise emission.

Organizational issues
Die Vorlesung wird als Videostream zur Verfügung gestellt. Sie finden den Videostream und das Vorlesungsmaterial auf ILIAS. Das ILIAS-Passwort erhalten Sie unter https://fast-web-01.fast.kit.edu/Passwoerterillias/
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 2024, 2 SWS, Language: English, Open in study portal

Content
1. Summary of the fundamentals of acoustics and vibrations

2. The relevance of road surface, wheel imperfections, springs, dampers, brakes, bearings and bushings, suspensions, engines and drive train for the acoustic and mechanical driving comfort:
   - phenomena
   - influencing parameters
   - types of construction
   - optimization of components and systems
   - conflicts of goals
   - methods of development

3. Noise emission of motor vehicles
   - noise stress
   - sound sources and influencing parameters
   - legal restraints
   - optimization of components and systems
   - conflict of goals
   - methods of development

Learning Objectives:
The students have knowledge about the noise and vibration properties of the chassis components and the drive train. They know what kind of noise and vibration phenomena do exist, what are the generation mechanisms behind, which components of the vehicle participate in which way and how could they be improved. They have knowledge in the subject area of noise emission of automobiles: Noise impact, legal requirements, sources and influencing parameters, component and system optimization, target conflicts and development methods. They are ready to analyze, to judge and to optimize the vehicle with its single components regarding acoustic and vibration phenomena. They are also able to contribute competently to the development of a vehicle regarding the noise emission.
Organizational issues
the lectures are available as a video stream.
You will find the lecture material and the videos on ILIAS. To get the ILIAS password, refer to https://fast-web-01.fast.kit.edu/PasswoerterIlias/
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.
Course: Vehicle Ergonomics [T-MACH-108374]

**Responsible:** Sofie Ehrhardt

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102815 - Major Field: Engineering Design

M-MACH-102818 - Major Field: Vehicle Technology

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**Events**

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**Exams**

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<th>Grading scale</th>
<th>Recurrence</th>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

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**Competence Certificate**

written exam, 60 minutes

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**Prerequisites**

none

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

**Vehicle Ergonomics**

2110050, SS 2024, 3 SWS, Language: German, Open in study portal

**Content**

- Basics of physical-body related ergonomics
- Basics of cognitive ergonomics
- Theories of driver behaviour
- interface design
- usability testing

Learning objective:

An ergonomic vehicle is best adapted to the requirements, needs and characteristics of its users and thus enables effective, efficient and satisfying interaction. After attending the lecture, students are able to analyse and evaluate the ergonomic quality of various vehicle concepts and derive design recommendations. They can consider aspects of both physical and cognitive ergonomics. Students are familiar with basic ergonomic methods, theories and concepts as well as with theories of human information processing, especially theories of driver behaviour. They are capable of critically reflecting this knowledge and applying it in a flexible way within the user-centered design process.

**Organizational issues**

Die Vorlesung hat einen Arbeitsaufwand von 120 h (= 4 LP).

**Literature**

Die Literaturliste wird in der Vorlesung ausgegeben. Die Folien zur Vorlesung stehen auf ILIAS zum Download zur Verfügung.

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

Lightweight Design
Part of: M-MACH-102638 - Major Field: Rail System Technology
M-MACH-102818 - Major Field: Vehicle Technology

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

Events

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<td>Vehicle Lightweight design – Strategies, Concepts, Materials</td>
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<td>Vehicle Lightweight Design - Strategies, Concepts, Materials</td>
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Competence Certificate

Written exam; Duration approx. 90 min

Prerequisites

none

Recommendation

none

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

Vehicle Lightweight design – Strategies, Concepts, Materials
2113102, WS 23/24, 2 SWS, Language: German, Open in study portal

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

Content

Strategies in lightweight design
Shape optimization, light weight materials, multi-materials and concepts for lightweight design

Construction methods
Differential, integral, sandwich, modular, bionic

Body construction
Shell, space frame, monocoque

Metalic materials
Steel, aluminium, magnesium, titan

Aim of this lecture:

Students learn that lightweight design is a process of realizing a demanded function by using the smallest possible mass. They understand lightweight construction as a complex optimization problem with multiple boundary conditions, involving competences from methods, materials and production.

Students learn the established lightweight strategies and ways of construction. They know the metallic materials used in lightweight construction and understand the relation between material and vehicle body.
Literature
### Course: Vehicle Systems for Urban Mobility [T-MACH-113069]

**Responsible:** Prof. Dr.-Ing. Martin Cichon  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102638 - Major Field: Rail System Technology

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**Exams**

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<td>Oral examination</td>
<td>2 SWS</td>
<td>Lecture / 🗣️</td>
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**Competence Certificate**

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

Legend: 🖥 Online, 🤕 Blended (On-Site/Online), 🗣️ On-Site, ✗ Cancelled
### 8.264 Course: Vibration Theory [T-MACH-105290]

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

**Part of:**  
- M-MACH-102746 - Compulsory Elective Module  
- M-MACH-102820 - Major Field: Mechatronics  
- M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics  
- M-MACH-104442 - Major Field: Vibration Theory  

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**Exams**

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**Competence Certificate**  
written exam, 180 min.

**Prerequisites**  
one

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

#### Vibration Theory

**2161212, WS 23/24, 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 23/24, 2 SWS, Language: German, Open in study portal**

**Practice (Ü)**

Bachelor's Program Mechanical Engineering (B.Sc.), Date: 23/02/2024  
Module Handbook, valid from Summer Term 2024
Content
Exercises related to the lecture
8.265 Course: Virtual Engineering (Specific Topics) [T-MACH-105381]

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

Part of: M-MACH-102746 - Compulsory Elective Module

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 exam, approx. 20 min.

Prerequisites
none

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

Virtual Engineering (Specific Topics)
3122031, SS 2024, 2 SWS, Language: English, Open in study portal

Content
Students can

- explain the basics of virtual engineering and name exemplary modeling tools and assign them to the corresponding methods and processes
- Formulate validation questions in the product development process and name obvious solution methods
- explain the basics of systems engineering and establish the connection to the product development process
- explain individual methods of the digital factory and present the functions of the digital factory in the context of the product creation process
- explain the theoretical and technical basics of Virtual Reality technology and show the connection to Virtual Engineering

Organizational issues
Zeit und Ort der Lehrveranstaltung siehe ILIAS / Time and place of the course see ILIAS.

Literature
Lecture slides / Vorlesungsfolien
# 8.266 Course: Virtual Reality Practical Course [T-MACH-102149]

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:**  
- M-MACH-102583 - Major Field: Information Management  
- M-MACH-102820 - Major Field: Mechatronics

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**Exams**

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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 23/24, 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
8.267 Course: Warehousing and Distribution Systems [T-MACH-105174]

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

**Part of:** M-MACH-102821 - Major Field: Technical Logistics

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**Events**

| ST 2024 | 2118097 | Warehousing and distribution systems | 2 SWS | Lecture / 🗣 Furmans |

Legend: • Online, Ⓚ Blended (On-Site/Online), 🗣 On-Site, x 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:*

**Warehousing and distribution systems**
2118097, SS 2024, 2 SWS, Language: German, Open in study portal

**Organizational issues**
Die Vorlesung wird in diesem Semester als Blockveranstaltung angeboten. Die Veranstaltungstermine sind:

- Mi., 24. April
- Do., 25. April
- Fr., 26. April

Die Vorlesung startet jeweils um 08:00 Uhr und findet im Selmayr-HS (Geb. 50.38) statt. Bitte beachten Sie für mögliche kurzfristige Raumänderungen die Informationen im ILIAS-Kurs.

**Literature**

- ARNOLD, Dieter, FURMANS, Kai (2005)
  Materialfluss in Logistiksystemen, 5. Auflage, Berlin: Springer-Verlag

- ARNOLD, Dieter (Hrsg.) et al. (2008)
  Handbuch Logistik, 3. Auflage, Berlin: Springer-Verlag

  Warehouse Science

- GUDEHUS, Timm (2005)
  Logistik, 3. Auflage, Berlin: Springer-Verlag

- FRAZELLE, Edward (2002)
  World-class warehousing and material handling, McGraw-Hill

- MARTIN, Heinrich (1999)
  Praxiswissen Materialflußplanung: Transport, Hanshaben, Lagern, Kommissionieren, Braunschweig, Wiesbaden: Vieweg

- WISSEr, Jens (2009)
  Der Prozess Lagern und Kommissionieren im Rahmen des Distribution Center Reference Model (DCRM); Karlsruhe: Universitätsverlag

Eine ausführliche Übersicht wissenschaftlicher Paper findet sich bei:

- ROODBERGEN, Kees Jan (2007)
  Warehouse Literature
### Course: Wave and Quantum Physics [T-PHYS-108322]

**Responsible:** apl. Prof. Dr. Gernot Goll  
napl. Prof. Dr. Bernd Pilawa

**Organisation:** KIT Department of Physics

**Part of:** M-PHYS-104030 - Physics

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

**Competence Certificate**

Written exam (usually about 180 min)

**Prerequisites**

none
8.269 Course: Welding Technology [T-MACH-105170]

**Responsible:** Dr. Majid Farajian  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

**Competence Certificate**

Oral exam, about 20 minutes

**Prerequisites**

none

**Recommendation**

Basics of material science (iron- and non-iron alloys), materials, processes and production, design.

All the relevant books of the German Welding Institute (DVS: Deutscher Verband für Schweißen und verwandte Verfahren) in the field of welding and joining is recommended.

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

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.
8.270 Course: Windpower [T-MACH-105234]

**Responsible:** Norbert Lewald

**Organisation:** KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology
M-MACH-102838 - Major Field: Energy Converting Engines

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

**Competence Certificate**
written exam, 120 minutes

**Prerequisites**
none

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

**Windpower**
2157381, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)
Responsibility: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102576 - Key Competences

<table>
<thead>
<tr>
<th>Type</th>
<th>Completed coursework</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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Events

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<th></th>
<th>2110969</th>
<th>Working Methods in Mechanical Engineering</th>
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<tr>
<td></td>
<td>1 SWS</td>
<td>Course ( / 📜)</td>
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<td>Deml</td>
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<td></td>
<td>2142975</td>
<td>Workshop 'Working Methods in Mechanical Engineering' (IMT)</td>
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<td>1 SWS</td>
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<td>2174970</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), ⌚ On-Site, ✗ Cancelled

Competence Certificate

e-learning module certificates, group exercises, submission of a scientific thesis of at least 30 pages and submission and execution of a maximal 30 minutes scientific presentation.

Prerequisites

none

Annotation

The course "Working Methods in Mechanical Engineering (ATM/WME)" (including the workshops) will be offered for the last time in summer semester 2024. If you do not pass or cannot attend WME, from summer semester 25 onwards, you will have to attend the lecture "Scientific work and empirical research methods" with an ungraded written exam (2 credits) and another course (2 credits) from the range of key qualifications offered in the next version of this module. If you have any questions, please contact the ifab office: elisabeth.schlund@kit.edu

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

Working Methods in Mechanical Engineering

2110969, SS 2024, 1 SWS, Language: English, Open in study portal

Course (Ku) Blended (On-Site/Online)

Organizational issues

The course addresses students in the Bachelor program Mechanical Engineering in the fourth semester. Students in the Bachelor program Mechanical Engineering in other semesters as well as students in the Master program Mechanical Engineering or other programs, may participate in case of vacancies. The introductory lecture will take place once on 16.04.2024. The course consists of an e-learning course, which ends with an online test, and an accompanying self-study in small groups. The group meetings take place every 14 days during the lecture period. Registration for the groups takes place via ilias.

The course "Working Methods in Mechanical Engineering (ATM/WME)" (including the workshops) will be offered for the last time in summer semester 2024. If you do not pass or cannot attend WME, from summer semester 25 onwards, you will have to attend the lecture "Scientific work and empirical research methods" with an ungraded written exam (2 credits) and another course (2 credits) from the range of key qualifications offered in the next version of this module. If you have any questions, please contact the ifab office: elisabeth.schlund@kit.edu

Workshop 'Working Methods in Mechanical Engineering' (IMT)

2142975, SS 2024, 1 SWS, Language: German, Open in study portal

Others (sonst.) Blended (On-Site/Online)
Content
Within the frame of a scientific conference the contents from the corresponding lesson will be implemented in a practical way. The students have to organise a scientific conference by themself. The contributions have to prepared by the students and will be presented within the frame of abstracts, conference articles, posters, and presentations.

1. part of the workshop - Organisation of a conference
   - Structure of a conference
   - Generation of workgroups - Committees
   - Exchange of Informations between workgroups
   - Decision-making based on the information available
   - Decision-making based under limitation of time
   - Generation of technical progam, budget, flyer etc. of the conference
   - Definition of criteria for abstracts - communication of criteria

2. part of the workshop - Investigation and writing of abstracts
   - Investigation in Literatur / Patent Database
   - Citation of scientific literature
   - Writing of abstracts
   - Evaluation of abstracts

3. part of the workshop - Writing of scientific conference contributions
   - Structure of a scientific article
   - Rules for scientific writing - style
   - Citation - Sources and their citation
   - Design of scientific posters
   - Design of a scientific presentation

4. part of the workshop - Moderation and presentation
   - Presentation of the results of the workshop - oral presentations
   - Presentation of posters
   - Moderation of the conference

Organizational issues
Ort/Termin s. Institutshomepage

Literature
Übungsskript - Wichtige Punkte über wissenschaftliches Schreiben, Zitieren, Postergestaltung, Moderation und Präsentation werden zusammengefasst und bilden einen kleinen Leitfaden für den Workshop

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

**Organisation:** KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology

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**Completed coursework:**

- WT 23/24: 2171488 Workshop on computer-based flow measurement techniques
- ST 2024: 2171488 Workshop on computer-based flow measurement techniques

**Credits:** 4

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**Exams**

- WT 23/24: 76-T-MACH-106707 Workshop on computer-based flow measurement techniques

**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, WS 23/24, 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, SS 2024, 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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