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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).
Universität des Landes Baden-Württemberg und nationales Forschungszentrum in der Helmholtz-Gemeinschaft

Amtliche Bekanntmachung

2015  Ausgegeben Karlsruhe, den 06. August 2015  Nr. 62

I n h a l t

Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Bachelorstudiengang Maschinenbau  381

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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.


§ 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 lehrveranstaltungs begleitend 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.
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 Einzelpprüfungen 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 Prüfungs 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:

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

Zur differenzierten Bewertung einzelner Prüfungsleistungen sind nur folgende Noten zugelassen:

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

(3) Studienleistungen werden mit „bestanden“ oder mit „nicht bestanden“ gewertet.
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>bis</th>
<th>Fachnote</th>
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<tbody>
<tr>
<td>1,5</td>
<td>sehr gut</td>
</tr>
<tr>
<td>1,6</td>
<td>bis 2,5</td>
</tr>
<tr>
<td>2,6</td>
<td>bis 3,5</td>
</tr>
<tr>
<td>3,6</td>
<td>bis 4,0</td>
</tr>
</tbody>
</table>

§ 8 Orientierungsprüfungen, Verlust des Prüfungsanspruchs

(1) 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).

(2) 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 eine 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 eine 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.

(3) Ist die Bachelorprüfung bis zum Ende des Prüfungszeitraums des neunten Fachsemesters einschließlich etwaiger Wiederholungen nicht vollständig abgelegt, so erlischt der Prüfungsan-

(4) Der Prüfungsanspruch geht auch verloren, wenn eine nach dieser Studien- und Prüfungsvorschriften erforderliche Prüfungs- 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 in Inhalt, Umfang und Form (mündlich oder schriftlich) der ersten entsprechen. Ausnahmen kann der zuständige Prüfungsausschuss auf Antrag zulassen.

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

(5) Studienleistungen können mehrfach wiederholt werden.

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

(7) Die Prüfungsleistung ist endgültig nicht bestanden, wenn die mündliche Nachprüfung im Sinne des Absatzes 1 mit „nicht ausreichend“ (5,0) bewertet wurde. Die Prüfungsleistung ist ferner endgültig nicht bestanden, wenn die mündliche Prüfung im Sinne des Absatzes 2 oder die Prüfungsergebnis 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 absolviierende Prüfungsleistung betreffen, ist auf Antrag eines Mitgliedes des Prüfungsausschusses eine fachlich zuständige und von der betroffenen KIT-Fakultät zu nennende prüfungsberechtigte Person hinzuzuziehen.


§ 18 Prüfende und Beisitzende

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

(2) Prüfende sind Hochschullehrer/innen sowie leitende Wissenschaftler/innen gemäß § 14 Abs. 3 Ziff. 1 KITG, habilitierte Mitglieder und akademische Mitarbeiter/innen gemäß § 52 LHG, welche der KIT-Fakultät angehören und denen die 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-
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 erloschen 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)
Amendment Statute

Bachelor Program Mechanical Engineering, Date: 15/09/2021
Module Handbook valid from Winter Term 21/22

Die Forschungsuniversität in der Helmholtz-Gemeinschaft

Amtliche Bekanntmachung

2019
Ausgegeben Karlsruhe, den 26. Februar 2019
Nr. 03

I n h a l t

Seite

Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Bachelor-studiengang Maschinenbau 26
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)
Inhaltsverzeichnis

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# Abkürzungsverzeichnis

**Semester:**
- WS: Wintersemester
- SS: Sommersemester

**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: Praktikumsschein, 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


1.2 Module des Bachelorstudiums


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1.3 Studienplan

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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>
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<tbody>
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<td>Antriebssysteme</td>
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<td>Bahnsystemtechnik</td>
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<td>Entwicklung und Konstruktion</td>
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<td>Kontinuumsmechanik</td>
<td>Böhike</td>
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<td>Grundlagen der Energietechnik</td>
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<tr>
<td>Kraftfahrzeugtechnik</td>
<td>Gaufterin</td>
<td>12</td>
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<tr>
<td>Kraft- und Arbeitsmaschinen</td>
<td>Th. Koch</td>
<td>24</td>
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<tr>
<td>Materialwissenschaft und Werkstofftechnik</td>
<td>Heilmeyer</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>Seemann</td>
<td>61</td>
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<tr>
<td>Produktionssysteme</td>
<td>Schulze</td>
<td>38</td>
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<td>Schwingungslehre</td>
<td>Fidlin</td>
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<td>Technische Logistik</td>
<td>Furmans</td>
<td>44</td>
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<tr>
<td>Technik des Verbrennungsmotors</td>
<td>Th. Koch</td>
<td>57</td>
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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 Schwerpunktmoduls mit mehr als 12 LP ist nur im Fall, dass die Addition innerhalb des Schwerpunktmoduls 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 Bachelorstudienangs festgelegt.
3 Änderungshistorie (ab 20.07.2016)

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## 5 Field of study structure

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<tr>
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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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### 5.1 Orientation Exam

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### 5.2 Bachelor Thesis

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### 5.3 Fundamentals of Engineering

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### 5.5 Interdisciplinary Qualifications

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6 Modules

6.1 Module: Advanced Mathematics [M-MATH-102859]

| Responsible: | Prof. Dr. Roland Griesmaier |
| Organisation: | KIT Department of Mathematics |
| Part of: | Fundamentals of Engineering |

<table>
<thead>
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Arens, Griesmaier, Hettlich

**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.

**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 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.

**Prerequisites**
None.

**Content**
Fundamentals, sequences and convergence, functions and continuity, series, differential calculus of one real variable, integral calculus, vector spaces, linear maps, eigenvalues, Fourier series, differential equations, Laplace transform, multidimensional calculus, domain integrals, vector calculus, partial differential equations, stochastics
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
6.2 Module: Bachelor Thesis [M-MACH-10494]

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

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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 by not less than a professor or a senior scientist according to § 14 Abs. 3 Ziff. 1 KITGor habilitated members of the KIT Faculty of Mechanical Engineering and another examiner. Generally, one of the two examiners is the person who has assigned the thesis. If the examiners do not agree, the 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.

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.

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 earn at least 120 credits in the following fields:
   - Fundamentals of Engineering
   - Interdisciplinary Qualifications
   - Specialization in Mechanical Engineering

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.
# MACH-102746: Compulsory Elective Module (BSc-Modul WPF)

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

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## Election block: Compulsary Elective Module (Tutorial) ()

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**Competence Certificate**  
oral/written exam
**Competence Goal**
The students have deepened their knowledge in selected areas of mechanical engineering. Due to the broad variety of eligible courses, they have supplemented / sharpened their own competence profile in mechanical engineering individually and precisely.
The specific learning outcomes are defined by the respective coordinator of the course.

**Prerequisites**
None

**Content**
See 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
### 6.4 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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| T-MACH-105206 | Computer Science for Engineers, Prerequisite  
This item will not influence the grade calculation of this parent. | 0 | Ovtcharova |

**Competence Certificate**  
Written examination "Computer Science for Engineers", 100%, 180 minutes; Examination prerequisite: passed lab course.

**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.

**Module grade calculation**  
Examination result "Computer Science for Engineers" 100%

**Prerequisites**  
None

**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.

**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
### Module: Electrical Engineering [M-ETIT-104801]

- **Responsible:** Dr.-Ing. Klaus-Peter Becker
- **Organisation:** KIT Department of Electrical Engineering and Information Technology
- **Part of:** Fundamentals of Engineering (Usage from 3/8/2019)

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6.6 Module: Engineering Mechanics (BSc-Modul 03, TM) [M-MACH-102572]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Fundamentals of Engineering

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<td>T-MACH-105203</td>
<td>Tutorial Engineering Mechanics IV</td>
<td>0</td>
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</tbody>
</table>

**Competence Certificate**

prerequisites EM I, II (see T-MACH-100528 "Engineering Mechanics I (Tutorial)" as well as T-MACH-100284 "Engineering Mechanics II (Tutorial)"); they consist of solving problems of the work sheets in four categories: written mandatory homework, written homework, computational homework, colloquia.

prerequisites EM III, IV

"Engineering Mechanics I", written exam, 90 minutes; graded:
"Engineering Mechanics II", written exam, 90 minutes; graded;
"Engineering Mechanics III/IV", written exam, 180 Minutes; graded;

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

**Competence Goal**

After having finished the lectures EM I and EM II the students can

- assess stress and strain distributions for the basic load cases within the framework of elasticity and thermoelasticity
- compute and evaluate 3D stress and strain states
- 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.

**Prerequisites**

None
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 theors 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

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, colloquiu, consultation hours (optional)
## 6.7 Module: Fluid Mechanics (BSc-Modul 12, SL) [M-MACH-102565]

### Responsible
Prof. Dr.-Ing. Bettina Frohnapfel

### Organisation
KIT Department of Mechanical Engineering

### Part of
Fundamentals of Engineering

<table>
<thead>
<tr>
<th>Credits</th>
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<th>Level</th>
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### Mandatory

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<tr>
<td>T-MACH-105207</td>
<td>Fluid Mechanics 1&amp;2</td>
<td>8 CR</td>
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### Competence Certificate
Common examination of "Fluid Mechanics I" and "Fluid Mechanics II"; written exam, 3 hours (graded)

### 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

### Module grade calculation
result of exam

### Prerequisites
none

### 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

### 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
6.8 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

<table>
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<th>Credits</th>
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<td>Each term</td>
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<td>German/English</td>
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</table>

**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”.

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<tr>
<td>T-MACH-105296</td>
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<table>
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<tr>
<th>Election block: Key Competences (at least 2 credits)</th>
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<tbody>
<tr>
<td>T-MACH-110961</td>
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<tr>
<td>T-MACH-111684</td>
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<tr>
<td>T-MACH-111685</td>
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</table>

**Competence Certificate**

Success is monitored within the framework of academic achievements.

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

**Competence Goal**

After completing the module Key Competences students can

- determine and coordinate work steps, projects and goals, proceed systematically and purposefully, set priorities as well as assess the feasibility of a task,
- apply the principles 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.

**Module grade calculation**

non graded

**Prerequisites**

none

**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".
**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.
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

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<th>Authors</th>
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<tbody>
<tr>
<td>T-MACH-105208</td>
<td>Machines and Processes</td>
<td>7 CR</td>
<td>Bauer, Kubach, Maas, Pritz</td>
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<tr>
<td>T-MACH-105232</td>
<td>Machines and Processes, Prerequisite</td>
<td>0 CR</td>
<td>Bauer, Kubach, Maas, Pritz</td>
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</table>

**Competence Certificate**

written exam (2 h)

**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.

**Module grade calculation**

Grade out of written exam (100%)

**Prerequisites**

None.

**Content**

- Internal combustion engines
- Hydraulic fluid machinery
- Thermal turbo machines
- Thermodynamics

**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
6.10 Module: Major Field: Combustion Engine Techniques (SP 57) [M-MACH-102645]

**Responsible:** Prof. Dr. Thomas Koch

**Organisation:** KIT Department of Mechanical Engineering

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

<table>
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<tr>
<th>Credits</th>
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</table>

**Mandatory**

- **T-MACH-105652** Fundamentals of Combustion Engine Technology 5 CR Bernhardt, Kubach, Pfeil, Toedter, Wagner

**Election block: Combustion Engine Techniques (K) (at least 3 credits)**

- **T-MACH-111623** Fuels and Lubricants for Engine Powertrains 4 CR Kehrwald, Kubach
- **T-MACH-110817** Development of hybrid drivetrains 4 CR Koch
- **T-MACH-105169** Engine Measurement Techniques 4 CR Bernhardt

**Election block: Combustion Engine Techniques (E) (at most 1 item)**

- **T-MACH-105173** Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines 4 CR Gohl
- **T-MACH-105649** Boosting of Combustion Engines 4 CR Kech, Kubach
- **T-MACH-110816** Großdiesel- und -gasmotoren für Schiffsantriebe 4 CR Kubach
- **T-MACH-105044** Fundamentals of Catalytic Exhaust Gas Aftreatment 4 CR Deutschmann, Grunwaldt, Kubach, Lox
- **T-MACH-105337** Engine Laboratory 4 CR Wagner
- **T-MACH-111578** Sustainable Vehicle Drivetrains 4 CR Koch, Toedter
- **T-MACH-111591** Turbo Charging of Internal Combustion Engines 4 CR Kech, Kubach
- **T-MACH-105985** Ignition Systems 4 CR Toedter

**Competence Certificate**

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

**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

**Prerequisites**

None

**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
6.11 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>
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<th>Credits</th>
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<th>Duration</th>
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<td>Each term</td>
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**Mandatory**

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<th>Credits</th>
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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-110836</td>
<td>Mathematical Methods in Continuum Mechanics</td>
<td>4 CR</td>
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**Election block: Continuum Mechanics (E) ()**

<table>
<thead>
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<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-105320</td>
<td>Introduction to the Finite Element Method</td>
<td>3 CR</td>
<td>Böhlke, Langhoff</td>
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**Election block: Continuum Mechanics (Ü) ()**

<table>
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<tr>
<td>T-MACH-110330</td>
<td>Tutorial Introduction to the Finite Element Method</td>
<td>1 CR</td>
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<tr>
<td>T-MACH-111033</td>
<td>Tutorial Introduction to Computational Fluid Dynamics</td>
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<td>Frohnapfel, Stroh</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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</tbody>
</table>

**Competence Certificate**
see different bricks

**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

**Prerequisites**

none

**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
### 6.12 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>
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<tr>
<th>Credits</th>
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<td>Each term</td>
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**Election block: Energy Converting Engines (K) (at least 8 credits)**

<table>
<thead>
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<th>Course Name</th>
<th>Credits</th>
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<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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**Election block: Energy Converting Engines (E) (at most 5 credits)**

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<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>
<td>Koch</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>
</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-102093</td>
<td>Fluid Power Systems</td>
<td>4 CR</td>
<td>Geimer, Pult</td>
</tr>
<tr>
<td>T-MACH-105533</td>
<td>Gasdynamics</td>
<td>4 CR</td>
<td>Magagnato</td>
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<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>
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<tr>
<td>T-MACH-105213</td>
<td>Fundamentals of Combustion I</td>
<td>4 CR</td>
<td>Maas</td>
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<tr>
<td>T-MACH-105325</td>
<td>Fundamentals of Combustion II</td>
<td>4 CR</td>
<td>Bykov, Maas</td>
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<tr>
<td>T-MACH-105337</td>
<td>Engine Laboratory</td>
<td>4 CR</td>
<td>Wagner</td>
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<tr>
<td>T-MACH-111578</td>
<td>Sustainable Vehicle Drivetrains</td>
<td>4 CR</td>
<td>Koch, Toedter</td>
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<td>T-MACH-105338</td>
<td>Numerical Fluid Mechanics</td>
<td>4 CR</td>
<td>Magagnato</td>
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<td>T-MACH-107447</td>
<td>Reliability Engineering 1</td>
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<td>Konnov</td>
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<td>T-MACH-105652</td>
<td>Fundamentals of Combustion Engine Technology</td>
<td>5 CR</td>
<td>Bernhardt, Kubach, Pfeil, Toedter, Wagner</td>
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<td>T-MACH-105364</td>
<td>Thermal Turbomachines II</td>
<td>6 CR</td>
<td>Bauer</td>
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<td>T-MACH-105366</td>
<td>Turbo Jet Engines</td>
<td>4 CR</td>
<td>Bauer</td>
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<td>T-MACH-105234</td>
<td>Windpower</td>
<td>4 CR</td>
<td>Lewald</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>
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<td>T-MACH-105985</td>
<td>Ignition Systems</td>
<td>4 CR</td>
<td>Toedter</td>
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**Competence Certificate**  
refer to different brick descriptions of SP24
**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.

**Prerequisites**
None

**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.

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

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

**Learning type**
Lectures and Exercises
## 6.13 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)

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

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

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<td>Applied Tribology in Industrial Product Development</td>
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<td>T-MACH-105311</td>
<td>Design and Development of Mobile Machines</td>
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<td>CAE-Workshop</td>
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<td>Designing with numerical methods in product development</td>
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<td>Vehicle Ergonomics</td>
<td>4 CR</td>
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<td>T-MACH-102105</td>
<td>Manufacturing Technology</td>
<td>8 CR</td>
<td>Schulze, Zanger</td>
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<td>T-MACH-100092</td>
<td>Automotive Engineering I</td>
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<td>Gauterin, Unrau</td>
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<td>Fundamentals for Design of Motor-Vehicle Bodies I</td>
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<td>Fundamentals for Design of Motor-Vehicle Bodies II</td>
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<td>T-MACH-105163</td>
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<td>T-MACH-105188</td>
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<td>Design with Plastics</td>
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<td>Leadership and Management Development</td>
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<td>Leadership and Conflict Management</td>
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<td>Project Management in Global Product Engineering Structures</td>
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<td>T-MACH-102107</td>
<td>Quality Management</td>
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<td>Safety Engineering</td>
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<td>Strategic Product Development - Identification of Potentials of Innovative Products - Case Study</td>
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<td>Technical Acoustics</td>
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<td>T-MACH-105361</td>
<td>Technical Design in Product Development</td>
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<td>Gear Cutting Technology</td>
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<td>T-MACH-110962</td>
<td>Machine Tools and High-Precision Manufacturing Systems</td>
<td>8 CR</td>
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### Election block: Engineering Design (P) (at most 4 credits)

Bachelor Program Mechanical Engineering  
Date: 15/09/2021  
Module Handbook valid from Winter Term 21/22
### Competence Goal
The students are able to transfer their knowledge und abilities in product engineering to mechanical systems in research and industrial practice.

### Prerequisites
None

### Content
see courses of the SP10

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

### Learning type
- lectures
- auditorium exercises
- workshops

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<td>T-MACH-105370</td>
<td>Laboratory Mechatronics</td>
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<td>T-MACH-111431</td>
<td>Programming in CAE-Applications</td>
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<td>Project Internship Aditive Manufacturing: Development and Production of an Additive Component</td>
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<td>T-MACH-108887</td>
<td>Design and Development of Mobile Machines - Advance</td>
<td>0 CR</td>
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### 6.14 Module: Major Field: Fundamentals of Energy Technology [M-MACH-102816]

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

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

<table>
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**Mandatory**

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**Election block: Fundamentals of Energy Technology (K) ()**

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<td>Introduction to Nuclear Energy</td>
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<td>T-MACH-105325</td>
<td>Fundamentals of Combustion II</td>
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<td>Bykov, Maas</td>
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<td>T-MACH-105326</td>
<td>Hydraulic Fluid Machinery</td>
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**Election block: Fundamentals of Energy Technology (E) ()**

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<td>T-MACH-105462</td>
<td>Selected Problems of Applied Reactor Physics and Exercises</td>
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<td>T-MACH-105151</td>
<td>Energy Efficient Intralogistic Systems</td>
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<td>T-MACH-105408</td>
<td>Energy Systems I: Renewable Energy</td>
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<td>T-MACH-105533</td>
<td>Gasdynamics</td>
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<td>Solar Thermal Energy Systems</td>
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<td>Flows and Heat Transfer in Energy Technology</td>
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<td>Thermal Solar Energy</td>
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<td>Windpower</td>
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**Election block: Fundamentals of Energy Technology (P) (at most 4 credits)**

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<td>T-MACH-105331</td>
<td>Laboratory Exercise in Energy Technology</td>
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<td>T-MACH-106707</td>
<td>Workshop on Computer-based Flow Measurement Techniques</td>
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**Competence Certificate**

- Oral exam

**Competence Goal**

After completion of SP 15 students are able:

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

**Prerequisites**

- None
Content
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
### 6.15 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)

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#### Election block: Information Management (K) (at least 8 credits)

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<td>T-MACH-105147</td>
<td>Product Lifecycle Management</td>
<td>4 CR</td>
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<td>T-MACH-102083</td>
<td>Integrated Information Systems for Engineers</td>
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#### Election block: Information Management (E) ()

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<td>CAE-Workshop</td>
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<td>Development Methods of Technical Systems</td>
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<td>T-MACH-102128</td>
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<td>IT-Fundamentals of Logistics</td>
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<td>Intellectual Property Rights and Strategies in Industrial Companies</td>
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<td>T-MACH-102187</td>
<td>CAD-NX Training Course</td>
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**Competence Certificate**  
Examination of other kind and oral and/or written examination: duration 2 hours.

**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.

**Prerequisites**  
None

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

**Workload**  
360 hours
Learning type
Lectures, Tutorials
### 6.16 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)

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**Election notes**

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

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

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<td>4 CR</td>
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<td>Data Analytics for Engineers</td>
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<td>Meisenbacher, Mikut, Reischl</td>
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<td>Digital Control</td>
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<td>T-MACH-105223</td>
<td>Machine Vision</td>
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<td>Measurement II</td>
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### Election block: Information Technology (E) (at most 6 credits)

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<td>Automotive Vision</td>
<td>6 CR</td>
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<td>Engine Measurement Techniques</td>
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<td>T-MACH-107447</td>
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<td>T-MACH-105185</td>
<td>Control Technology</td>
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<td>Behaviour Generation for Vehicles</td>
<td>6 CR</td>
<td>Naumann, Werting</td>
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<td>Laboratory Mechatronics</td>
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<td>Hagenmeyer, Seemann, Stiller</td>
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<tr>
<td>T-MACH-105341</td>
<td>Lab Computer-Aided Methods for Measurement and Control</td>
<td>4 CR</td>
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**Competence Certificate**

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

**Competence Goal**

Students are able to

- explain fundamentals of information technology for given problems in mechanical engineering an mechatronics.  
- explain major methods for acquisition, processing and exploitation of information in technical systems.  
- outline and to explain alternative methods to determine and to represent measurement uncertainties and their propagation in technical systems.  
- explain information filters and fusion methods and understand their application to given problems.

**Prerequisites**

none

**Content**

- Techniques of information and data processing in mechanical engineering  
- Techniques of sensor data processing  
- Concepts of control theory  
- Electronic devices for data processing
Workload
The workload is about 360 hours, corresponding to 12 credit points.

Learning type
lecture, practical training, exercise, practical training in laboratory
### 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:** 6

**Election notes**

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

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

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

Prerequisites
None

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

Annotation
The module Materials Science and Engineering consists of 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.
### 6.18 Module: Major Field: Mechatronics (SP 31) [M-MACH-102820]

**Responsible:** Prof. Dr. Veit Hagenmeyer  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Specialization in Mechanical Engineering (Major Field)

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

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<td>T-MACH-105694</td>
<td>Data Analytics for Engineers</td>
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<td>T-MACH-100535</td>
<td>Introduction into Mechatronics</td>
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<tr>
<td>T-MACH-105209</td>
<td>Introduction into the Multi-Body Dynamics</td>
<td>5 CR</td>
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<td>Seemann</td>
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<td>T-MACH-105218</td>
<td>Automotive Vision</td>
<td>6 CR</td>
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<td>Behaviour Generation for Vehicles</td>
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**Election block: Mechatronics (E) (at most 1 item)**

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<td>T-MACH-102150</td>
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<td>T-MACH-105210</td>
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Competence Certificate
Written exam and oral exam.

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.

Prerequisites
none

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.
6.19 Module: Major Field: Modeling and Simulation in Dynamics (SP 61) [M-MACH-104430]

**Responsible:** Prof. Dr.-Ing. Wolfgang Seemann

**Organisation:** KIT Department of Mechanical Engineering

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

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

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<td>T-MACH-105209</td>
<td>Introduction into the Multi-Body Dynamics</td>
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<td>Seemann</td>
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**Election block: Modeling and Simulation in Dynamics (E) (at most 5 credits)**

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<td>5 CR</td>
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**Competence Certificate**
oral examination

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

**Prerequisites**
None

**Content**
This module deals with 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
### 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>
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<th>Credits</th>
<th>Grading scale</th>
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<th>Duration</th>
<th>Language</th>
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<td>Each term</td>
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**Election notes:**
In the core area of each Major Field at least 8 ECTS have to be chosen.

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

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<thead>
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<tbody>
<tr>
<td>T-MACH-105307</td>
<td>Drive Train of Mobile Machines</td>
<td>4</td>
<td>Geimer, Wydra</td>
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<tr>
<td>T-MACH-105233</td>
<td>Powertrain Systems Technology A: Automotive Systems</td>
<td>4</td>
<td>Albers, Matthiesen, Ott</td>
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<tr>
<td>T-MACH-105216</td>
<td>Powertrain Systems Technology B: Stationary Machinery</td>
<td>4</td>
<td>Albers, Matthiesen, Ott</td>
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<tr>
<td>T-MACH-105226</td>
<td>Dynamics of the Automotive Drive Train</td>
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#### Election block: Powertrain Systems (E)

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<tr>
<td>T-MACH-105215</td>
<td>Applied Tribology in Industrial Product Development</td>
<td>4</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</td>
<td>Albers, Faust</td>
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<tr>
<td>T-MACH-102150</td>
<td>BUS-Controls</td>
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<td>Becker, Geimer</td>
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<tr>
<td>T-MACH-105209</td>
<td>Introduction into the Multi-Body Dynamics</td>
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<td>Energy Efficient Intralogistic Systems</td>
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<td>Hybrid and Electric Vehicles</td>
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<td>T-MACH-105187</td>
<td>IT-Fundamentals of Logistics</td>
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<td>Leadership and Management Development</td>
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<td>T-MACH-102152</td>
<td>Novel Actuators and Sensors</td>
<td>4</td>
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<td>T-MACH-105442</td>
<td>Intellectual Property Rights and Strategies in Industrial Companies</td>
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<td>Production Technology for E-Mobility</td>
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<td>Development of Oil-Hydraulic Powertrain Systems</td>
<td>4</td>
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<td>T-MACH-105347</td>
<td>Project Management in Global Product Engineering Structures</td>
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<td>T-MACH-105185</td>
<td>Control Technology</td>
<td>4</td>
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<td>T-MACH-105696</td>
<td>Strategic Product Development - Identification of Potentials of Innovative Products</td>
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<td>Strategic Product Development - Identification of Potentials of Innovative Products - Case Study</td>
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<td>Tribology</td>
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<td>T-MACH-102194</td>
<td>Combustion Engines I</td>
<td>4</td>
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<tr>
<td>T-MACH-102140</td>
<td>Failure of Structural Materials: Deformation and Fracture</td>
<td>4</td>
<td>Gumbsch, Weygand</td>
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<tr>
<td>T-MACH-102148</td>
<td>Gear Cutting Technology</td>
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#### Election block: Powertrain Systems (Ü)

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<tbody>
<tr>
<td>T-MACH-109303</td>
<td>Exercices - Tribology</td>
<td>0</td>
<td>Dienwiebel</td>
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</table>
Competence Goal
The students know and understand the technical and physical basics and systematic connections of drive systems. The lecture deals vehicle drive systems as well as drive systems for stationary and mobile work machines. They are able to choose, describe and use complex dimensioning- and design methods for drive systems under consideration of the interactions of the system.

Prerequisites
none

Content
See courses of the SP02

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

Learning type
lectures
auditorium exercises
workshops
6.21 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>
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<td>Each term</td>
<td>2 terms</td>
<td>German</td>
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**Election block: Production Systems (K) (at least 8 credits)**

- T-MACH-105518 Human Factors Engineering I 4 CR Deml
- T-MACH-105519 Human Factors Engineering II 4 CR Deml
- T-MACH-102105 Manufacturing Technology 8 CR Schulze, Zanger
- T-MACH-108849 Integrated Production Planning in the Age of Industry 4.0 8 CR Lanza
- T-MACH-102151 Material Flow in Logistic Systems 9 CR Furmans
- T-MACH-110962 Machine Tools and High-Precision Manufacturing Systems 8 CR Fleischer

**Election block: Production Systems (E) ()**

- T-MACH-108844 Automated Manufacturing Systems 8 CR Fleischer
- T-MACH-105147 Product Lifecycle Management 4 CR Ovtcharova
- T-MACH-102107 Quality Management 4 CR Lanza
- T-MACH-102083 Integrated Information Systems for Engineers 4 CR Ovtcharova

**Election block: Production Systems (P) (at most 4 credits)**

- T-MACH-108878 Laboratory Production Metrology 4 CR Häfner
- T-MACH-110960 Project Internship Additive Manufacturing: Development and Production of an Additive Component 4 CR Zanger

**Competence Certificate**

Oral exams: duration approx. 5 min per credit point

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

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

**Competence Goal**

The students...

- are able to 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.

**Prerequisites**

None

**Content**

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

**Workload**

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

**Learning type**

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

**Responsible:** Prof. Dr.-Ing. Marcus Geimer  
Prof. Dr.-Ing. Peter Gratzfeld  
**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** 2

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<th>Credits</th>
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<td>T-MACH-106424</td>
<td>4 CR</td>
<td>Rail System Technology</td>
<td>Geimer, Gratzfeld</td>
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<tr>
<td>T-MACH-105353</td>
<td>4 CR</td>
<td>Rail Vehicle Technology</td>
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<th>Credits</th>
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<td>T-MACH-105540</td>
<td>4 CR</td>
<td>Railways in the Transportation Market</td>
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<td>T-MACH-102121</td>
<td>4 CR</td>
<td>Electric Rail Vehicles</td>
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<tr>
<td>T-MACH-105237</td>
<td>4 CR</td>
<td>Vehicle Lightweight Design - Strategies, Concepts, Materials</td>
<td>Henning</td>
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<tr>
<td>T-MACH-105218</td>
<td>6 CR</td>
<td>Automotive Vision</td>
<td>Lauer, Stiller</td>
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<tr>
<td>T-MACH-105535</td>
<td>4 CR</td>
<td>Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies</td>
<td>Henning</td>
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<tr>
<td>T-MACH-105350</td>
<td>4 CR</td>
<td>Computational Vehicle Dynamics</td>
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<tr>
<td>T-MACH-108692</td>
<td>3 CR</td>
<td>Seminar for Rail System Technology</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.

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

#### Prerequisites
None
Content

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations
8. Vehicle system technology: structure and main systems of rail vehicles
9. Car body: functions, requirements, design principles, crash elements, coupling, doors and windows
10. Bogies: forces, running gears, bogies, Jakobs-bogies, active components, connection to car body, wheel arrangement
11. Drives: 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.
6.23 Module: Major Field: Technical Logistics (SP 44) [M-MACH-102821]

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

Part of: Specialization in Mechanical Engineering (Major Field)

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<td>Basics of Technical Logistics I</td>
<td>4 CR</td>
<td>Mittwollen, Oellerich</td>
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<td>T-MACH-109920</td>
<td>Basics of Technical Logistics II</td>
<td>5 CR</td>
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**Elective block: Technical Logistics (E) ()**

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<tr>
<td>T-MACH-102160</td>
<td>Selected Applications of Technical Logistics</td>
<td>4 CR</td>
<td>Milushev, Mittwollen</td>
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<tr>
<td>T-MACH-108945</td>
<td>Selected Applications of Technical Logistics - Project</td>
<td>2 CR</td>
<td>Milushev, Mittwollen</td>
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<tr>
<td>T-MACH-102159</td>
<td>Elements and Systems of Technical Logistics</td>
<td>4 CR</td>
<td>Fischer, Mittwollen</td>
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<td>T-MACH-108946</td>
<td>Elements and Systems of Technical Logistics - Project</td>
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<td>T-MACH-105174</td>
<td>Warehousing and Distribution Systems</td>
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<td>Kitt, Lauer, Stiller</td>
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<td>T-MACH-105367</td>
<td>Behaviour Generation for Vehicles</td>
<td>6 CR</td>
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**Competence Certificate**
Written and oral exams, see brick courses

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

**Prerequisites**
None

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

**Workload**
The 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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<td>Automotive Engineering I</td>
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#### Election block: Automotive Technology (E) ()

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<td>Alternative Powertrain for Automobiles</td>
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<td>Albers, Matthiesen, Ott</td>
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<tr>
<td>T-MACH-110958</td>
<td>Design and Optimization of Conventional and Electrified Automotive Transmissions</td>
<td>4</td>
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<td>Automated Manufacturing Systems</td>
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<td>T-MACH-111550</td>
<td>CO2-Neutral Combustion Engines and their Fuels I</td>
<td>4</td>
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<td>Development of hybrid drivetrains</td>
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<td>Handling Characteristics of Motor Vehicles I</td>
<td>4</td>
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<td>T-MACH-105153</td>
<td>Handling Characteristics of Motor Vehicles II</td>
<td>4</td>
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<td>Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice</td>
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### Module: Major Field: Vehicle Technology (SP 12) [M-MACH-102818]

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<tr>
<td>T-MACH-105442</td>
<td>Intellectual Property Rights and Strategies in Industrial Companies</td>
<td>4 CR</td>
<td>Albers, Matthiesen, Zacharias</td>
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<tr>
<td>T-MACH-110984</td>
<td>Production Technology for E-Mobility</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-110318</td>
<td>Product- and Production-Concepts for Modern Automobiles</td>
<td>4 CR</td>
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<tr>
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<td>Product, Process and Resource Integration in the Automotive Industry</td>
<td>4 CR</td>
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<tr>
<td>T-MACH-102156</td>
<td>Project Workshop: Automotive Engineering</td>
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<td>T-MACH-110796</td>
<td>Python Algorithm for Vehicle Technology</td>
<td>4 CR</td>
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<td>T-MACH-105441</td>
<td>Development of Oil-Hydraulic Powertrain Systems</td>
<td>4 CR</td>
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<td>T-MACH-105347</td>
<td>Project Management in Global Product Engineering Structures</td>
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<td>Hydrogen and reFuels - Energy Conversion in Combustion Engines</td>
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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.

### 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 competitively in the development of vehicles.

### Prerequisites
None

### 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 aggregate like engine, gear, drive train, chasis 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.
### 6.25 Module: Major Field: Vibration Theory [M-MACH-104442]

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

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<tr>
<th>Credits</th>
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**Election block: Vibration Theory (K) (at least 8 credits)**

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

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<tr>
<td>T-MACH-105226</td>
<td>Dynamics of the Automotive Drive Train</td>
<td>5 CR</td>
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<td>T-MACH-111260</td>
<td>Dynamics of Electro-Mechanical Systems</td>
<td>5 CR</td>
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<tr>
<td>T-MACH-105514</td>
<td>Experimental Dynamics</td>
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<td>T-MACH-105373</td>
<td>Practical Training in Measurement of Vibrations</td>
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<td>T-MACH-105443</td>
<td>Wave Propagation</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: Dr.-Ing. Michael Gerstenmeyer
            Prof. Dr.-Ing. Volker Schulze

Organisation: KIT Department of Mechanical Engineering

Part of: Fundamentals of Engineering

<table>
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Mandatory

| T-MACH-105219 | Basics of Manufacturing Technology | 4 CR | Schulze |

Competence Certificate
written exam (duration: 60 min)

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.

Prerequisites
none

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]

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

Part of: Fundamentals of Engineering

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<td>T-MACH-105146</td>
<td>Materials Science Lab Course</td>
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<td>Gibmeier, Heilmaier, Pundt</td>
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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.

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

Prerequisites
none

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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### Mandatory

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

#### Competence Certificate

**Type of Examination:** written exam  
**Duration of Examination:** 150 minutes

#### 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.

#### Module grade calculation

result of exam

#### Prerequisites

none

#### 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

#### Recommendation

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

#### 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

#### 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]

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

**Part of:** Fundamentals of Engineering

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</tbody>
</table>

#### Competence Certificate

**Mechanical Design I & 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 60 min plus reading time

**Mechanical Design III & 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

#### 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.

#### Prerequisites

None
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 * 1.5 h = 22.5 h
Presence in exercises: 8 * 1.5 h = 12 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 * 1.5 h = 22.5 h
Presence in exercises: 7 * 1.5 h = 10.5 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: 135 h
Project work in a team: 90h
Personal preparation and follow-up of lecture and exercise: 45h
Total: 180 h = 6 LP

MKL 4:
Presence: 40.5 h
Attendance lectures (13 L): 19.5h
Presence exercises (6 exercises): 9h
Attendance milestones project work (3x 4h): 12h
Self-study: 169.5 h
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
6.30 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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Mandatory

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<th>Course Title</th>
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<tr>
<td>T-MATH-100275</td>
<td>Advanced Mathematics I</td>
<td>7 CR</td>
<td>Arens, Griesmaier, Hettlich</td>
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<tr>
<td>T-MACH-100282</td>
<td>Engineering Mechanics I</td>
<td>7 CR</td>
<td>Böhike, Langhoff</td>
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<tr>
<td>T-MACH-100283</td>
<td>Engineering Mechanics II</td>
<td>6 CR</td>
<td>Böhike, Langhoff</td>
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</table>

Modelled deadline
This module must be passed until the end of the 3. term.

Annotation
The deadline for taking the orientation exam shall be extended by two semesters for first-year students of the winter semester of 2018/19 and first-year students of the winter semester of 2019/20, provided that they were enrolled in the same degree program during both semesters.

For first-year students of the winter semester of 2020/2021 or for students who have changed their degree program for the winter semester of 2020/2021, the deadline for taking the orientation exam shall be extended by one semester.
### 6.31 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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**Mandatory**

| T-PHYS-108322 | Wave and Quantum Physics | 5 CR | Goll, Pilawa |

**Competence Certificate**

The assessment consists of a written exam according to Section 4(2). 1 of the examination regulation.

**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 the 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

**Prerequisites**

None

**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
Module: Production Operations Management [M-MACH-100297]

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

Part of: Fundamentals of Engineering

<table>
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<td>Production Operations Management</td>
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<tr>
<td>T-MACH-108734</td>
<td>Production Operations Management-Project</td>
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Furmans, Lanza, Schultmann

Competence Certificate

The success control takes place in the form of partial examinations in the individual courses of the module. These are a written exam (duration: 90 minutes) and a different type of examination. The module grade is made up of the grades of the courses in the module weighted by credit points.

Competence Goal

If you successfully passed this course you will be able to:

- state the relevant technical terms of business administration, logistics and production engineering
- describe the interrelation between these technical terms
- describe the most important decision problems qualitatively and quantitatively
- apply the appropriate decision models to solve the respective decision problems
- critically evaluate the results and draw appropriate conclusions
- extend the learned methods and models by researching on your own

Prerequisites

none

Content

The institutes alternate with each cycle. Basic skills about the planning and operation of a production plant are taught. The lecture covers the basics of operations and supply chain management as well as business management basics in accounting, investment calculation and legal forms.

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) the module (including all brick details, exams and courses) is offered in English.

Workload

Attendance time: 42 hours,
Self-study: 108 hours

Learning type

1. Lectures (Obligatory)
2. Tutorials (Obligatory)
3. Group work (Obligatory)
4. Oral defense of the group work (Obligatory)
6.33 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

<table>
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<td>8 CR</td>
<td>Maas</td>
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<td>T-MACH-105287</td>
<td>Technical Thermodynamics and Heat Transfer II</td>
<td>7 CR</td>
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<td>Exercises in Technical Thermodynamics and Heat Transfer I</td>
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<td>T-MACH-105288</td>
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</table>

Competence Certificate
Prerequisite: attestation each semester by homework assignments
Thermodynamics I: Written exam, graded, approx. 3 hours
Thermodynamics II: Written exam, graded, approx. 3 hours

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

An integral part of the model is that students can define the fundamental laws of thermodynamics and their application. 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 of humid air as well explaining the properties on a molecular basis and analyzing them with the help of the laws of thermodynamic. Furthermore, the students are capable of explaining chemical reactions in the context of thermodynamics as well as defining and applying the heat transfer mechanisms.

Module grade calculation
weight according to CP

Prerequisites
None

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
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
7 Courses

### 7.1 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>0131000</td>
<td>Höhere Mathematik I für die Fachrichtung Maschinenbau, Geodäsie, Materialwissenschaft und Werkstofftechnik</td>
<td>4</td>
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<td>Griesmaier</td>
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<td>0131200</td>
<td>Höhere Mathematik I für die Fachrichtungen Chemieingenieurwesen, Verfahrenstechnik, Bioingenieurwesen und MIT</td>
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<td>Lecture</td>
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**Exams**

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<th>Code</th>
<th>Course Title</th>
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<td>6700025</td>
<td>Advanced Mathematics I</td>
<td>Arens, Griesmaier, Hettlich</td>
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</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.
### 7.2 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

<table>
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#### Events

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<td>Hettlich</td>
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#### Exams

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<td>Advanced Mathematics II</td>
<td>Arens, Griesmaier, Hettlich</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**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.
7 COURSES

**7.3 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>0131400</td>
<td>Höhere Mathematik III für die Fachrichtungen Maschinenbau, Chemieingenieurwesen, Verfahrenstechnik, Bioingenieurwesen und das Lehramt Maschinenbau</td>
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**Exams**

| ST 2021 | 6700002 | Advanced Mathematics III |

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

**Prerequisites**
A “pass” result on the pre-requisite in AM III is a requirement for registration for the examination in AM III.

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

1. The course T-MATH-100527 - Tutorial Advanced Mathematics III must have been passed.
7 COURSES

Course: Agile Product Innovation Management - Value-driven Planning of New Products [T-MACH-106744]

7.4 Course: Agile Product Innovation Management - Value-driven Planning of New Products [T-MACH-106744]

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

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

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<td>Each summer term</td>
<td>3</td>
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Events

| ST 2021 | 2122300 | Agile product innovation management - value-driven planning of new products | Lecture / Practice ( / X) Kläger |

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

Competence Certificate

Oral examination, 20 min.

Prerequisites

None

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

V Agile product innovation management - value-driven planning of new products
2122300, SS 2021, SWS, Language: German, Open in study portal

Lecture / Practice (VÜ) Cancelled

Content

Students are able to

• replicate the essential correlations, procedures and structure elements for the product / innovation planning and to use it as a guideline for the planning of new products
• describe agile innovation processes and the essential prerequisites
• demonstrate the added value of a product in consideration of a system-oriented approach. In addition, they are able to interpret unique selling points (USP)
• deduce the correlation between the added value of superior products and the creativity/innovation
• to apply methods and tools for digital product planning on specific use cases
• explain elements and methods of computer-based ideas management and requirements modeling
• describe the support of the product planning process by RP systems accompanying the development process and select 3D printing processes suitable for specific applications

Literature

Vorlesungsfolien / Lecture slides
7.5 Course: Airport Logistics [T-MACH-105175]

**Responsible:** Dr.-Ing. André Richter

**Organisation:** KIT Department of Mechanical Engineering

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

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**Events**

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<td>WT 21/22</td>
<td>2117056</td>
<td>Airport logistics</td>
<td>2 SWS</td>
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**Legend:** 🖥 Online, 🏭 Blended (On-Site/Online), ⚰ On-Site, 🗑 Cancelled

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

**Prerequisites**
none

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

**Airport logistics**

2117056, WS 21/22, 2 SWS, Language: German, Open in study portal

**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/IFL-Homepage

**Literature**
"Gepäcklogistik auf Flughäfen" à http://www.springer.com/de/book/9783642328527
7 COURSES

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

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

Responsible: Prof. Dipl.-Ing. Karl Ernst Noreikat
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102818 - Major Field: Vehicle Technology

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Events

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<td>Sustainable Vehicle Drivetrains (Alternative Powertrain for Automobiles)</td>
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<td>Sustainable Vehicle Drivetrains</td>
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</tbody>
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Exams

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

Competence Certificate

written exam

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

Sustainable Vehicle Drivetrains

2133132, WS 21/22, 2 SWS, Open in study portal

Content

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

**Responsible:** Dr.-Ing. Marcus Gohl

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102645 - Major Field: Combustion Engine Techniques

<table>
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<th>Recurrence</th>
<th>Version</th>
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<td>4</td>
<td>Grade to a third</td>
<td>Each summer term</td>
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</table>

**Events**

| ST 2021   | 2134150 | Analysis of Exhaust Gas und Lubricating Oil in Combustion Engines | 2 SWS | Lecture / 🧩 | Gohl |

**Exams**

| ST 2021   | 76--T-Mach-105173 | Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines | Gohl |

**Competence Certificate**

Letter of attendance or oral exam (25 minutes, no auxiliary means)

**Prerequisites**

none

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

**Analysis of Exhaust Gas und Lubricating Oil in Combustion Engines**

2134150, SS 2021, 2 SWS, Language: German, Open in study portal

**Literature**

Die Vorlesungsunterlagen werden vor jeder Veranstaltung an die Studenten verteilt.
7.8 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

**Type**  
Oral 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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<td>Each winter term</td>
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**Version**  
2

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

**Competence Certificate**

oral exam (20 min)

**Prerequisites**

None

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

**Applied Tribology in Industrial Product Development**

2145181, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V) On-Site**

**Content**

The aim of the lecture is to discuss tribological problems, tribological features and the tribological variety on examples of the industry.

The students are able to

- define a tribological system,
- design a tribological system,
- discuss wear and damage impacts,
- explain measurement techniques to investigate tribological systems and
- show the limits of a tribological system.

Further content:

- Friction, Wear, Wear Measurement
- Lubricant (Oil, Grease, etc.)
- Hydrodynamic and elastohydrodynamic Lubrication
- Design of Tribologic Working Surface Pairs
- Technique of Measurement in Lubricated Contacts
- Prevention of Maschine Failure
- Protective Surface Layers
- Journal Bearings, Roller Bearings
- Gear Wheels and Transmissions

Regular attendance: 21 h  
Self-study: 99 h  
Exam: oral exam
Literature
Vorlesungsfolien werden im Ilias veröffentlicht.
The lecture script will be allocated at Ilias.
7.9 Course: Atomistic Simulations and Molecular Dynamics [T-MACH-105308]

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

**Organisation:** KIT Department of Mechanical Engineering

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

**Events**

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<td>76T-MACH-105308</td>
<td>Atomistic Simulations and Molecular Dynamics</td>
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<td>Grade to a third</td>
<td>Each summer term</td>
<td>3</td>
<td>Weygand, Gumbsch</td>
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</tbody>
</table>

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

**Prerequisites**
none

**Recommendation**
preliminary knowledge in mathematics, physics and materials science

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

**Atomistic simulations and molecular dynamics**
2181740, SS 2021, 3 SWS, Language: English, Open in study portal

**Lecture / Practice (VÜ)**
Online
Content
The lecture introduces the foundation of particle based simulation methods focussing on molecular dynamics:

1. Introduction
2. Physics of Materials
3. MD Basics, Atom-Billard
   * particle, position, energy, forces, pair potentials
   * initial and boundary conditions
   * time integration
4. Algorithms
5. Statics, dynamics, thermodynamics
6. MD output
7. interaction between particles
   * pair potential -- many body potentials
   * principles of quantum mechanics
   * tight binding methods
   * dissipative particle dynamics
8. Application of particle based methods

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

The student can

- describe the physical foundation of particle based simulation method (e.g. molecular dynamics)
- apply particle based simulation methods to problems in materials science

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 22,5 hours
exercise: 22,5 hours
self-study: 75 hours
oral exam ca. 30 minutes

Organizational issues
Die Vorlesung wird auf Englisch angeboten!


Kontakt: daniel.weygand@kit.edu

Admission to the course is possible until 15.4.2021 (first lecture) without password. The course is offered asynchronously. The lecture slides and an audio review of the most important elements of the lecture will be made accessible via ILIAS.

Literature

7 COURSES

Course: Automated Manufacturing Systems [T-MACH-108844]

7.10 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>Each summer term</td>
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Events

| ST 2021   | 2150904 | Automated Manufacturing Systems | 6 SWS | Lecture / Practice ( / Fleischer |

Exams

| ST 2021   | 76-T-MACH-108844 | Automated Manufacturing Systems | Fleischer |

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 2021, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
Online
Content
The lecture provides an overview of the structure and functioning of automated manufacturing systems. In the introduction chapter the basic elements for the realization of automated manufacturing systems are given. This includes:

- Drive and control technology
- Handling technology for handling work pieces and tools
- Industrial Robotics
- Quality assurance in automated manufacturing
- automatic machines, cells, centers and systems for manufacturing and assembly
- structures of multi-machine systems
- planning of automated manufacturing systems

An interdisciplinary view of these subareas enables Industry 4.0 solutions.

In the second part of the lecture, the basics are illustrated using implemented manufacturing processes for the production of automotive components (chassis and drive technology). The analysis of automated manufacturing systems for manufacturing of defined components is also included.

In the field of vehicle power train both, the automated manufacturing process for the production of the conventional internal-combustion engine and the automated manufacturing process for the production of the prospective electric power train (electric motor and battery) are considered. In the field of car body, the focus is on the analysis of the process chain for the automated manufacturing of conventional sheet metal body parts, as well as for automated manufacturing of body components made out of fiber-reinforced plastics.

Within tutorials, the contents from the lecture are advanced and applied to specific problems and tasks.

Learning Outcomes:
The students …

- are able to analyze implemented automated manufacturing systems and describe their components.
- are capable to assess the implemented examples of implemented automated manufacturing systems and apply them to new problems.
- are able to name automation tasks in manufacturing plants and name the components which are necessary for the implementation of each automation task.
- are capable with respect to a given task to plan the configuration of an automated manufacturing system and to determine the necessary components to its realization.
- are able to design and select components for a given use case of the categories: "Handling Technology", "Industrial Robotics", "Sensory" and "Controls".
- are capable to compare different concepts for multi-machine systems and select a suitable concept for a given use case.

Workload:

MACH:
regular attendance: 63 hours
self-study: 177 hours

WING:
regular attendance: 63 hours
self-study: 207 hours

Organizational issues
Vorlesungstermine dienstags 8.00 Uhr und donnerstags 8.00 Uhr, Übungstermine donnerstags 9.45 Uhr. Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung.

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

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

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

**Organisation:** KIT Department of Mechanical Engineering

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

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**Events**

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<td>Automotive Engineering</td>
<td>4 SWS</td>
<td>Gauterin, Unrau</td>
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<tr>
<td>WT 21/22 2113809</td>
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<td>4 SWS</td>
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**Exams**

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<th>Credits</th>
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<td>Unrau, Gauterin</td>
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</table>

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

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**Competence Certificate**

Written examination

Duration: 120 minutes

Auxiliary means: none

**Prerequisites**

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

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

### Automotive Engineering I

2113805, WS 21/22, 4 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
On-Site

#### Content

1. History and future of the automobile
2. Driving mechanics: driving resistances and driving performance, mechanics of longitudinal and lateral forces, active and passive safety
3. Drive systems: combustion engine, hybrid and electric drive systems
4. Transmission: clutches (e.g. friction clutch, viscous clutch), transmission (e.g. mechanical transmission, hydraulic fluid transmission)
5. Power transmission and distribution: drive shafts, cardan joints, differentials

**Learning Objectives:**

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

**Organizational issues**

Kann nicht mit der Veranstaltung [2113809] kombiniert werden.  
Can not be combined with lecture [2113809].
Literature

Automotive Engineering I
2113809, WS 21/22, 4 SWS, Language: English, Open in study portal

Content
1. History and future of the automobile
2. Driving mechanics: driving resistances and driving performances, mechanics of longitudinal and lateral forces, active and passive safety
3. Drive systems: combustion engine, hybrid and electric drive systems
4. Transmission: clutches (e.g. friction clutch, visco clutch), transmission (e.g. mechanical transmission, hydraulic fluid transmission)
5. Power transmission and distribution: drive shafts, cardon joints, differentials

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

Organizational issues
Kann nicht mit LV Grundlagen der Fahrzeugtechnik I [2113805] kombiniert werden.
Can not be combined with lecture [2113805] Grundlagen der Fahrzeugtechnik I.

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

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

### Organisation:
KIT Department of Mechanical Engineering

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

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### Events

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### Exams

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<td>WT 21/22</td>
<td>2</td>
<td>Automotive Engineering II</td>
<td>Gauterin, Unrau</td>
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Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Written Examination

Duration: 90 minutes

Auxiliary means: none

### Prerequisites

none

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

### Automotive Engineering II

2114835, SS 2021, 2 SWS, Language: German, Open in study portal

#### Content

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

#### Learning Objectives:

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

#### Organizational issues

Kann nicht mit der Veranstaltung [2114855] kombiniert werden.  
Can not be combined with lecture [2114855]
Literature

Automotive Engineering II
2114855, SS 2021, 2 SWS, Language: English, Open in study portal

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

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

Literature
Elective literature:
7.13 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  | Credits  | Grading scale  | Recurrence  | Version  
--- | --- | --- | --- | ---  
Written examination  | 6  | Grade to a third  | Each summer term  | 2  

Events  
ST 2021 | 2138340 | Automotive Vision | 3 SWS | Lecture / 🖥 | Lauer, Peter  

Exams  
ST 2021 | 76-T-MACH-105218 | Automotive Vision | | |  

Stiller, Lauer  

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

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

Prerequisites  
none

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.
7.14 Course: Bachelor Thesis [T-MACH-109188]

**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 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 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 earn 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.
# 7.15 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>2137301</td>
<td>Measurement and Control Systems</td>
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<td>Lecture / 👤</td>
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**Exams**

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<tr>
<td>ST 2021</td>
<td>76-T-MACH-104745</td>
<td>Basis of Measurement and Control Systems</td>
<td>2,5 hours</td>
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</table>

**Prerequisites**

none

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

**Measurement and Control Systems**  
2137301, WS 21/22, 3 SWS, Language: German, [Open in study portal](#)  
Lecture (V)  
On-Site
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

Organizational issues
Mittwochs: die ersten vier Vorlesungen online (20.10., 27.10., 10.11., 24.11.), Präsenz 08.12., 12.01., 26.01.

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

Measurement and Control Systems
3137020, WS 21/22, 3 SWS, Language: English, Open in study portal
Content
Lehrinhalt (EN):
1 Dynamic systems
2 Properties of important systems and modeling
3 Transfer characteristics and stability
4 Controller design
5 Fundamentals of measurement
6 Estimation
7 Sensors
8 Introduction to digital measurement

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

Nachweis (EN): written exam; duration 2,5 h; paper reference materials only (no calculator)
Arbeitsaufwand (EN): 180 hours

Organizational issues
Dienstags finden die ersten vier Vorlesungen (19.10. 26.10., 09.11., 23.11.) online, danach in Präsenz statt (07.12., 11.01., 25.01.).

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

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

- Messtechnische Bücher:
  W. Pfeiffer: Elektrische Messtechnik, VDE Verlag Berlin 1999
  Kronmüller, H.: Prinzipien der Prozeßmeßtechnik 2, Schnäcker-Verlag, Karlsruhe, 1. Aufl., 1980
7.16 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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**Exams**

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<td>76-T-MACH-105219</td>
<td>Basics of Manufacturing Technology</td>
<td>Schulze</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

written exam (duration: 60 min)

**Prerequisites**

none

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

**Basics of Manufacturing Technology**

2149658, WS 21/22, 2 SWS, Language: German, Open in study portal  
| Lecture / Practice (VÜ) | Blended (On-Site/Online) |
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: 21 hours
self-study: 99 hours

Organizational issues
Start: 20.10.2021

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

Media:
Lecture notes will be provided in ilias (https://ilias.studium.kit.edu).
Course: Basics of Technical Logistics I [T-MACH-109919]

Responsible: Dr.-Ing. Martin Mittwollen
Jan Oellerich

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102746 - Compulsory Elective Module
M-MACH-102821 - Major Field: Technical Logistics

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Exams

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<td>Lecture / Practice (VÜ)</td>
<td>Mittwollen</td>
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</table>

Prerequisites

none

Recommendation

Knowledge of the basics of technical mechanics preconditioned.

Competence Certificate

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

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

Basics of Technical Logistics

2117095, WS 21/22, 3 SWS, Language: German, Open in study portal

Blended (On-Site/Online)

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
7.18 Course: Basics of Technical Logistics II [T-MACH-109920]

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

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<td>Basics of Technical Logistics II</td>
<td>Mittwollen, Hochstein</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

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

**Responsible:** Maximilian Naumann  
Dr. 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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**Exams**

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**Competence Certificate**

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

**Prerequisites**

none

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

**Behaviour Generation for Vehicles**

2138336, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Content**

**Lernziele (EN):**

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

Nachweis: written exam  
Arbeitsaufwand: 120 hours

**Organizational issues**


**Literature**

Foliensatz zur Veranstaltung wird als kostenlose pdf-Datei bereitgestellt. Weitere Empfehlungen werden in der Vorlesung bekannt gegeben.
**7.20 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

<table>
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<td>Biomechanics: Design in Nature and Inspired by Nature</td>
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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:**

**V Biomechanics: Design in Nature and Inspired by Nature**  
2181708, WS 21/22, 3 SWS, Language: German, [Open in study portal](#)  
**On-Site**

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

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

**Regular attendance:** 30 hours  
**Self-study:** 90 hours
7.21 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  

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

**Competence Certificate**
oral exam, 20 min  

**Prerequisites**
none
### 7.22 Course: BUS-Controls [T-MACH-102150]

**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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#### Events

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**Legend:**  
🖥 Online,  
🧩 Blended (On-Site/Online),  
_echo_ 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.

#### Prerequisites

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

#### Modeled Conditions

The following conditions have to be fulfilled:

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

#### Recommendation

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

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

#### Annotation

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

After the practical oriented lessons the students will be able to visualize the communication structure of different applications, design basic systems and evaluate the complexity of programming of the complete system. Hereunto the students program in the practical orientated lessons IFM-controllers using the programming environment CoDeSys.

#### Content:

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

#### Literature:


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

---

Bachelor Program Mechanical Engineering  
Date: 15/09/2021  
Module Handbook valid from Winter Term 21/22
Content

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

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

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

Literature

Weiterführende Literatur:

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

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

**Organisation:** KIT Department of Mechanical Engineering

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

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**Exams**

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<td>76-T-MACH-108889</td>
<td>BUS-Controls - Advance</td>
<td>Geimer</td>
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<td>WT 21/22</td>
<td>76-T-MACH-108889</td>
<td>BUS-Controls - Advance</td>
<td>Geimer</td>
</tr>
</tbody>
</table>

**Competence Certificate**

Creation of control program

**Prerequisites**

none
7.24 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

<table>
<thead>
<tr>
<th>Events</th>
<th>Credits</th>
<th>Type</th>
<th>Grading scale</th>
<th>Recurrence</th>
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<td>Each term</td>
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</table>

**Competence Certificate**
Practical verification as academic achievement by working on a design task on the CAD computer, duration: 60 min.

**Prerequisites**
None

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

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

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

**CAD-NX training course**  
2123357, SS 2021, 2 SWS, Language: German/English, Open in study portal

**Practical course (P)**  
Blended (On-Site/Online)

**Content**

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

Students are able to:

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

**Organizational issues**
Das Praktikum wird mehrmals in der vorlesungsfreien Zeit als einwöchige Blockveranstaltung angeboten. Weitere Informationen siehe ILIAS.

**Literature**
Praktikumsskript
**CAD-NX training course**
2123357, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**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
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- use advanced, knowledge-based functionalities of NX to automate the creation of geometry and thus to ensure the reusability of the models.

**Organizational issues**
Siehe ILIAS zur Lehrveranstaltung

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

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

Organisation: KIT Department of Mechanical Engineering

Part of:  
M-MACH-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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Events

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

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
For a successful participation in the examination a continuous attendance at the workshop days is necessary. Limited number of participants. Selection is made according to a selection procedure.

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

CAE-Workshop
2147175, SS 2021, 3 SWS, Language: German, Open in study portal

Content
Content:

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

The students are able to:

- name the purposes and limits of numerical simulation and optimization of the virtual product development.
- solve simple realistic tasks in the field of finite element analysis, multi-body-simulation and structure optimization with industrial common software (the content in winter and summer term is different).
- evaluate and to question the results of a simulation.
- identify and improve the mistakes of a simulation or optimization.

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

Organizational issues
Wir empfehlen den Workshop ab dem 5. Semester.
Anmeldung erforderlich. Weitere Informationen siehe IPEK-Homepage.
Anwesenheitspflicht
Literature
Kursunterlagen werden in Ilias bereitgestellt.
Content is provided on Ilias.

CAE-Workshop
2147175, WS 21/22, 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
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- evaluate and to question the results of a simulation.
- identify and improve the mistakes of a simulation or optimization.

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

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

Literature
Kursunterlagen werden in Ilias bereitgestellt.
Content is provided on Ilias.
7.26 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

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Exams

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<td>Practical course /</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
2123358, SS 2021, 3 SWS, Language: German/English, Open in study portal

Practical course (P)
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 wird mehrmals in der vorlesungsfreien Zeit als einwöchige Blockveranstaltung angeboten. 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 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

Siehe ILIAS zur Lehrveranstaltung

Literature

Praktikumskript
7.27 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

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**Events**

| WT 21/22  | 2133113 | CO2-neutral combustion engines and their fuels I | 4 SWS | Lecture / Practice ( / ) | Koch |

**Exams**

| WT 21/22 | 76-T-MACH-102194 | CO2-neutral combustion engines and their fuels I | 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:**

**CO2-neutral combustion engines and their fuels I**
2133113, WS 21/22, 4 SWS, Language: German, Open in study portal

**Content**

Introduction, History, Concepts
Working Principle and Applications
Characteristic Parameters
Engine Parts
Drive Train
Fuels
Gasoline Engines
Diesel Engines
Exhaust Gas Aftertreatment
## 7.28 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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**Events**

| ST 2021 | 2134151 | CO2-neutral combustion engines and their fuels II | 3 SWS | Lecture / Practice ( / 🧩) | Koch |

<table>
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<th>Exams</th>
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<tbody>
<tr>
<td>WT 21/22</td>
</tr>
</tbody>
</table>

**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 2021, 3 SWS, Language: German, Open in study portal  
Lecture / Practice (VÜ)  
Blended (On-Site/Online)
7.29 Course: Cognitive Automobiles - Laboratory [T-MACH-105378]

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

Organisation: KIT Department of Mechanical Engineering

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

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Events

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<th>Stiller, Lauer, Kamran</th>
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Exams

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<th>Cognitive Automobiles - Laboratory</th>
<th>Stiller</th>
</tr>
</thead>
</table>

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:

<table>
<thead>
<tr>
<th>Cognitive Automobiles - Laboratory</th>
<th>2138341, SS 2021, 3 SWS, Language: German, Open in study portal</th>
<th>Blended (On-Site/Online)</th>
</tr>
</thead>
</table>

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.
7 COURSES

Course: Combustion Engines I [T-MACH-102194]

7.30 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

<table>
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Events

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Exams

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, History, Concepts
Working Principle and Applications
Characteristic Parameters
Engine Parts
Drive Train
Fuels
Gasoline Engines
Diesel Engines
Exhaust Gas Aftertreatment
### Course: Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies [T-MACH-105535]

**Responsible:** Prof. Dr.-Ing. Frank Henning  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102638 - Major Field: Rail System Technology  
M-MACH-102818 - Major Field: Vehicle Technology

<table>
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**Events**

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**Exams**

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<td>Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies</td>
<td>Henning</td>
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</table>

**Competence Certificate**

written exam 90 minutes

**Prerequisites**

none

---

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

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

2114053, SS 2021, 2 SWS, Language: German, [Open in study portal](#)
Content

Physical connections of fiber reinforcement

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

Resins
- Thermoplastics
- Duromeres

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

Semi-finished products - textiles

Process technologies - prepregs

Recycling of composites

Aim of this lecture:
Students know different polymer resin materials and fiber materials and can deduce their character and use. They understand the reinforcing effect of fibers in a matrix surrounding as well as the tasks of the single components in a compound. They know about the influence of the length of fibers, their mechanical characters and performance in a polymer matrix compound.

Student know the important industrial production processes for continuous and discontinuous reinforced polymer matrix compounds.

Literature

Literatur Leichtbau II

[1-7]
7.32 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

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**Exams**

<table>
<thead>
<tr>
<th>Events</th>
<th>Credits</th>
<th>Grade</th>
<th>Recurrence</th>
<th>Version</th>
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<tr>
<td>ST 2021</td>
<td>2</td>
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<td>Internal exam</td>
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</table>

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

**Competence Certificate**

oral exam, 30 min.

**Prerequisites**

none

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

**Computational Dynamics**

2162246, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Content**

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

**Organizational issues**

Fr., 15:45-17:15, Geb. 10.91, Grashof-Hörsaal

**Literature**

1. Ein Vorlesungsskript wird bereitgestellt!
7.33 Course: Computational Intelligence [T-MACH-105314]

Responsible: apl. Prof. Dr. Ralf Mikut
Dr. Ines Reinartz
apl. Prof. Dr. Markus Reischl

Organisation: KIT Department of Mechanical Engineering

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

<table>
<thead>
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Events

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<td>Computational Intelligence</td>
<td>2 SWS</td>
<td>Lecture</td>
<td>Mikut, Reischl, Reinartz</td>
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<td>Computational Intelligence</td>
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</table>

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

Competence Certificate
Written exam (Duration: 1h)

Prerequisites
none

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

Computational Intelligence
2105016, WS 21/22, 2 SWS, Language: German, Open in study portal

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

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

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

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


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


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

Events
ST 2021 2162256  Computational Vehicle Dynamics 2 SWS  Lecture / Online  Proppe

Exams
ST 2021 76-T-MACH-105350  Computational Vehicle Dynamics  Proppe

Competence Certificate
oral exam, 30 min.

Prerequisites
none

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

Computational Vehicle Dynamics 2162256, SS 2021, 2 SWS, Language: German, Open in study portal

Content
This course serves as an introduction into the computational modelling and simulation of technical system road/vehicle. A method based perspective is taken which allows for a unified treatment of various kinds of vehicles. The vehicle model is obtained by dividing the system into functional subsystems and defining interfaces between these subsystems. 

In the first part of the course, vehicle models will be developed based on models of the suspensions, the road, and the contact forces between road and vehicle. The focus of the second part of the course is on computational methods for linear and non-linear models of vehicle systems. The third part of the course discusses design criteria for stability, safety and ride comfort. Multibody dynamics simulations will be carried out using Matlab/Simulink.

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

Literature
**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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<th>Recurrence</th>
<th>Version</th>
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<th>Recurrence</th>
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<td>4 SWS</td>
<td>Lecture / Practice (🖥)</td>
<td>Ovtcharova, Elstermann</td>
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<td>ST 2021 3121034 Computer Science for Engineers</td>
<td>4 SWS</td>
<td>Lecture / Practice (🖥)</td>
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</table>

**Exams**  
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<th>Recurrence</th>
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<tr>
<td>WT 21/22 76-T-MACH-105205 Computer Science for Engineers - German</td>
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Legend: 🖥 Online, 🧬 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**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**  
2121390, SS 2021, 4 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)** Online

**V**

**Computer Science for Engineers**  
3121034, SS 2021, 4 SWS, Language: English, Open in study portal

**Lecture / Practice (VÜ)** Online

**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**  

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


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
Location/time see lecture homepage

Literature
### 7.36 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

<table>
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<th>Computer Lab for Computer Science in Mechanical Engineering</th>
<th>2 SWS</th>
<th>Ovtcharova, Mitarbeiter</th>
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<tbody>
<tr>
<td>ST 2021</td>
<td>3121036</td>
<td>Computer Science for Engineers Lab Course</td>
<td>2 SWS</td>
<td>Ovtcharova, Elstermann</td>
</tr>
</tbody>
</table>

**Exams**

| ST 2021  | 76-T-MACH-105206 | Computer Science for Engineers, Prerequisite | Ovtcharova |

**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 2021, 2 SWS, Language: German, [Open in study portal](#)  
**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 2021, 2 SWS, Language: English, [Open in study portal](#)  
**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
### 7.37 Course: Computerized Multibody Dynamics [T-MACH-105384]

- **Responsible:** Prof. Dr.-Ing. Wolfgang Seemann
- **Organisation:** KIT Department of Mechanical Engineering
- **Part of:** M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics

<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, 30 min.

#### Prerequisites
none

#### Recommendation
Knowledge of EM III/IV
7.38 Course: Constitution and Properties of Wear resistant materials [T-MACH-102141]

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

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

Type | Credits | Grading scale | Recurrence | Version
--- | --- | --- | --- | ---
Oral examination | 4 | Grade to a third | Each summer term | 3

Events

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<td>2 SWS</td>
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<td>Ulrich</td>
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Exams

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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:

**Constitution and Properties of Wear resistant materials**

2194643, SS 2021, 2 SWS, Language: German, Open in study portal

Lecture (V)

Online

Content

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

Teaching Content:

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

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

Recommendations: none
Organizational issues
Aufgrund der aktuellen Situation findet die Blockveranstaltung online in folgendem Zeitraum statt:
06.04.-08.04.2021: jeweils von 8:00-16:00 Uhr;
Ort: online per MS-Teams
Anmeldung verbindlich bis zum 02.04.2021 unter sven.ulrich@kit.edu.
Nach der Anmeldung wird Ihnen der Link zur Vorlesung per E-Mail am 05.04.2021 mitgeteilt.

Literature
Schneider, J.: Schneidkeramik, Verlag moderne Industrie, Landsberg am Lech, 1995
Kopien der Abbildungen und Tabellen werden verteilt; Copies with figures and tables will be distributed
7.39 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

**Type**
- Written examination
**Credits**
- 3

**Grading scale**
- Grade to a third

**Recurrence**
- Each winter term

**Expansion**
- 1 terms

**Version**
- 2

**Events**

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<tbody>
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<td>Written examination</td>
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<td>Lecture / Online</td>
<td>Each winter term</td>
<td>1 terms</td>
<td>2</td>
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</table>

**Competence Certificate**

Written examination (90 min). Additives as announced

**Prerequisites**

passing the corresponding "Tutorial Continuum Mechanics of Solids and Fluids" (T-MACH-110333)

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-110333 - Tutorial Continuum Mechanics of Solids and Fluids must have been passed.

**Annotation**

Due to capacity reasons it is possible that not all students of this course can be admitted to the computer tutorials. Students of the bachelor's degree program in mechanical engineering who have chosen the Major Field Continuum Mechanics (SP-Nr 13) and students of the bachelor's degree program in material science and material technology will be admitted to the computer tutorials in any case.

If additional places are available in the computer tutorials for this course, these will be allocated according to the BSc average grade.

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

**Continuum mechanics of solids and fluids**

2161252, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**

Blended (On-Site/Online)

**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
### 7.40 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>
<thead>
<tr>
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**Events**

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<td>2 SWS</td>
<td>Lecture</td>
<td>Gönnheimer</td>
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**Exams**

| ST 2021 | 76-T-MACH-105185 | Control Technology | Gönnheimer |

**Competence Certificate**

Written Exam (60 min)

**Prerequisites**

none

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

#### Control Technology

2150683, SS 2021, 2 SWS, Language: German, [Open in study portal](#)
Content
The lecture control technology gives an integral overview of available control components within the field of industrial production systems. The first part of the lecture deals with the fundamentals of signal processing and with control peripherals in the form of sensors and actors which are used in production systems for the detection and manipulation of process states. The second part handles with the function of electric control systems in the production environment. The main focus in this chapter is laid on programmable logic controls, computerized numerical controls and robot controls. Finally the course ends with the topic of cross-linking and decentralization with the help of bus systems. The lecture is very practice-oriented and illustrated with numerous examples from different branches.

The following topics will be covered:

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

Learning Outcomes:
The students …

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

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

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

Media:
Lecture notes will be provided in ilias (https://ilias.studium.kit.edu/).
7.41 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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<tbody>
<tr>
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<td>2106014</td>
<td>Data Analytics for Engineers</td>
<td>3</td>
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<td>Mikut, Reischl, Meisenbacher</td>
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**Exams**

<table>
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<td>Datenanalyse für Ingenieure</td>
<td>Mikut, Reischl</td>
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**Prerequisites**

none

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

**Data Analytics for Engineers**

2106014, SS 2021, 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): 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)


7.42 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

<table>
<thead>
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<th>Events</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
</tr>
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<tr>
<td>WT 21/22</td>
<td>2113079</td>
<td>Design and Development of Mobile Machines</td>
<td>2 SWS</td>
<td>Lecture / ≥</td>
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**Exams**

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<th>Grading scale</th>
<th>Recurrence</th>
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<td>Design and Development of Mobile Machines</td>
<td>2 SWS</td>
<td>Grade to a third</td>
<td>Each winter term</td>
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<td>Design and Development of Mobile Machines</td>
<td>2 SWS</td>
<td>Grade to a third</td>
<td>Each winter term</td>
<td>1</td>
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</table>

**Competence Certificate**

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

Bachelor Program Mechanical Engineering  Date: 15/09/2021
Module Handbook valid from Winter Term 21/22
Design and Development of Mobile Machines
2113079, WS 21/22, 2 SWS, Language: German, Open in study portal

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

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

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

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

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

Recommendations:
Knowledge in Fluid Technology (SoSe, LV 21093)

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

Literature
Keine.
7.43 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**

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<td>Design and Development of Mobile Machines - Advance</td>
<td>Geimer</td>
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<tr>
<td>WT 21/22</td>
<td>76-T-MACH-108887</td>
<td>Design and Development of Mobile Machines - Advance</td>
<td>Geimer</td>
</tr>
</tbody>
</table>

**Competence Certificate**
Preparation of semester report

**Prerequisites**
none
7.44 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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<td>Each summer term</td>
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**Events**

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<td>Design and Optimization of Conventional and Electrified Automotive Transmissions</td>
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**Exams**

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<td>Lecture</td>
<td>Faust, Albers</td>
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**Competence Certificate**
oral exam (20 min)

**Prerequisites**
none

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

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

2146208, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**

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

Lernziele
Die Studenten erwerben das Wissen aus aktuellen Getriebe-, Hybrid- und reinen Elektroantriebs-Entwicklungen über …

- die Funktionsweise und Auslegung von konventionellen und elektrifizierten Fahrzeuggetrieben und deren Komponenten;
- Konstruktions- und Funktionsprinzipien der wichtigsten Komponenten von Handschalt-, Doppelkupplungs-, stufenlosen und Planetenautomat-Getrieben;
- komfortrelevante Zusammenhänge und Abhilfemaßnahmen;
- die Hybridisierung und Elektrifizierung der Triebstränge auf Basis bekannter Getriebetypen und mit speziellen sogenannten Dedicated Hybrid Transmissions (DHT) sowie Bewertung der Konzepte auf Systemebene.
### 7.45 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>
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<td>Design of a Jet Engine Combustion Chamber</td>
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**Competence Certificate**  
The examination is an oral examination on lecture 22527 with a duration of 20 minutes.

**Prerequisites**  
None
7.46 Course: Design with Plastics [T-MACH-105330]

- **Responsible:** 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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<th>Design with Plastics</th>
<th>2 SWS</th>
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<th>Liedel</th>
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**Exams**

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<th>Design with Plastics</th>
<th>Liedel</th>
</tr>
</thead>
</table>

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

**Competence Certificate**

- Oral exam, about 20 minutes

**Prerequisites**

- none

**Recommendation**

- Poly I

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

**Design with Plastics**

- 2174571, SS 2021, 2 SWS, Language: German, Open in study portal
- Lecture (V) Cancelled
Content
Structure and properties of plastics materials,
Processing of plastics,
Behavior of plastics under environmental impacts,
Classic strength dimensioning,
Geometric dimensioning,
Plastic appropriate design,
Failure examples,
Joining of plastic parts,
Supporting simulation tools,
Structural foams,
Plastics Technology trends.

Learning objectives:
Students will be able to

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

Requirements:
none,

Recommendation: Polymerengineering I

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

Organizational Issues

Literature
Materialien werden in der Vorlesung ausgegeben.
Literaturhinweise werden in der Vorlesung gegeben.
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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**Events**

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**Exams**

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<th>Credits</th>
<th>Lecture (V)</th>
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<td>Designing with numerical methods in product development</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Oral examination (duration: 20 min)

**Prerequisites**

None

**Annotation**

The lecture notes are made available via ILIAS.

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

**Content**


**Organizational issues**

Beginn ab 11.11.2021

**Literature**

Vorlesungsskript
### 7.48 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

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**Events**

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<td>2121002</td>
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<td>4 SWS</td>
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<td>WT 21/22</td>
<td>2121002</td>
<td>Development methods of technical systems</td>
<td>4 SWS</td>
<td>Project (P)</td>
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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, SS 2021, 4 SWS, Language: German/English, [Open in study portal](#)  
*Project (PRO) Blended (On-Site/Online)*

**Content**

Requirements, SysML, Modelica, FEM high performance computing, process modeling, VR/AR  
Students can exemplarily:

- Collect requirements for large technical systems (e.g.: Helmholtz large-scale device KATRIN).  
- Describe physical systems across domains with the modeling language Modelica and simulate the systems behavior.  
- Generate 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.  

**Organizational issues**

Siehe ILIAS und Homepage zur Lehrveranstaltung

**Development methods of technical systems**

2121002, WS 21/22, 4 SWS, Language: German/English, [Open in study portal](#)  
*Project (PRO) Blended (On-Site/Online)*

**Content**

Requirements, SysML, Modelica, FEM high performance computing, process modeling, VR/AR  
Students can exemplarily:

- Collect requirements for large technical systems (e.g.: Helmholtz large-scale device KATRIN).  
- Describe physical systems across domains with the modeling language Modelica and simulate the systems behavior.  
- Generate 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.  

**Organizational issues**

Siehe ILIAS und Homepage zur Lehrveranstaltung

* Bachelor Program Mechanical Engineering, Date: 15/09/2021  
* Module Handbook valid from Winter Term 21/22  
* 161
### 7.49 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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<td>Each summer term</td>
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**Events**

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<th>Development of Hybrid Powertrains</th>
<th>2 SWS</th>
<th>Lecture / 🧩</th>
<th>Koch, Doppelbauer</th>
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</thead>
</table>

**Competence Certificate**  
written exam, 1 hour

**Prerequisites**  
None

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

**Development of Hybrid Powertrains**  
2134155, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**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
7.50 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

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Events

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<tr>
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<td>Development of Oil-Hydraulic Powertrain Systems</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 (20 min)

Prerequisites
none

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

Development of Oil-Hydraulic Powertrain Systems
2113072, WS 21/22, 2 SWS, Language: German, Open in study portal

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
7.51 Course: Digital Control [T-MACH-105317]

Responsible: 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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<th>Recurrence</th>
<th>Version</th>
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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

written exam
60 min.

Prerequisites

none

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

Digital Control

2137309, WS 21/22, 2 SWS, Language: German, Open in study portal

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

Arbeitsaufwand: 120 hours

Literature

- Föllinger, O.: Lineare Abtastsysteme. 4. Auflage, R. Oldenbourg Verlag, München Wien 1990
## 7.52 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

### Events

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### Exams

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

### Competence Certificate

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

### Prerequisites

none

### Recommendation

- General principles of mechanics 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:
Content
In this course will be discussed the different drive train of mobile machinerys. The fokus of this course is:
- improve knowledge of fundamentals
- mechanical gears
- torque converter
- hydrostatic drives
- continuous variable transmission
- 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
## 7.53 Course: Dynamics of Electro-Mechanical Systems [T-MACH-111260]

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

**Part of:**  
- M-MACH-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
- 1

### Events

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### Exams

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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:

**Dynamics of electro-mechanical systems**

2162210, SS 2021, 2 SWS, Language: German, Open in study portal

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

### Content

The lecture conveys two kinds of describing electro-mechanical systems. The first one (described shortly) is based on state and flow variables, the second one (which is in the focus of the course) is based on an energetic description and the Lagrange-Maxwell-Formalism. These methods are then applied in order to analyse the most important electro-mechanical systems. These include:

- Dynamics of electro-mechanical converter and vibration exciters taking into account the load in resonance operation
- Dynamics of electrical machines taking into account the rotordynamic effects (imbalance, loss of stability, passage through resonance)
- Dynamics of piezo-electrical converters in sensor and actor operation
# 7.54 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

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<th>Lecture / 📍</th>
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<td>2163112</td>
<td>Übungen zu Dynamik des Kfz-Antriebsstrangs</td>
<td>2 SWS</td>
<td>Practice</td>
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</table>

**Exams**  
ST 2021 76-T-MACH-105226 Dynamics of the Automotive Drive Train Fidlin

**Competence Certificate**  
Oral examination, 30 min.

**Prerequisites**  
none

**Recommendation**  
Powertrain Systems Technology A: Automotive SystemsMachine DynamicsVibration Theory

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

## Dynamics of the Automotive Drive Train

**2163111, WS 21/22, 2 SWS, Language: German, Open in study portal**  
**Type:** Lecture (V)  
**Credits:** 5  
**Grading scale:** Grade to a third  
**Recurrence:** Each winter term  
**Version:** 1

**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 21/22, 2 SWS, Language: German, Open in study portal**  
**Type:** Practice (Ü)  

**Content**  
Exercises related to the lecture
7.55 Course: Electric Rail Vehicles [T-MACH-102121]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102638 - Major Field: Rail System Technology

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**Events**

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<th>2114346</th>
<th>Electric Rail Vehicles</th>
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<th>Lecture / 🖥</th>
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**Exams**

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<td>Electric Rail Vehicles</td>
<td>Otto, Tesar, Gratzfeld</td>
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<td>76-T-MACH-102121</td>
<td>Electric Rail Vehicles</td>
<td>Tesar, Otto, Gerhardt, Gratzfeld</td>
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</table>

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

**Competence Certificate**

**Oral examination**

Duration: ca. 20 minutes  
No tools or reference materials may be used during the exam.

**Prerequisites**

none

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

**Electric Rail Vehicles**

2114346, SS 2021, 2 SWS, Language: German, Open in study portal

**Lecture (V) Online**

**Content**

1. Introduction: history of electric traction in railways, economic impact  
2. Wheel-rail-contact: carrying of vehicle mass, adhesion, current return  
3. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles  
4. Electric drives: purpose of electric drive and basic configurations, traction motors, converters, drives for vehicles at dc and ac lines and without contact wire, multi-system, dual power and hybrid vehicles, conventional drives for existing vehicles  
5. Train control management system: definitions, bus systems, components, network architectures, examples, future trends  
6. Vehicle concepts: modern vehicle concepts for mass transit and electric main line  
7. Traction power supply: power supply of railway vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire

**Organizational issues**

Die Vorlesung "Elektrische Schienenfahrzeuge" findet im SS 2021 als asynchrone Online-Veranstaltung statt.

**Literature**

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.  
A bibliography is available for download (Ilias-platform).
### 7.56 Course: Electrical Engineering and Electronics [T-ETIT-109820]

**Responsible:** Dr.-Ing. Klaus-Peter Becker  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-104801 - Electrical Engineering

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<td>2 SWS</td>
<td>Practice</td>
<td>Becker, Mitarbeiter*innen</td>
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</table>

**Exams**

| ST 2021    | 7306351 | Electrical Engineering and Electronics for Mechanical Engineers | Becker |

**Annotation**

Exam will be held in german language
7.57 Course: Elements and Systems of Technical Logistics [T-MACH-102159]

**Responsible:**
- Georg Fischer
- Dr.-Ing. Martin Mittwollen

**Organisation:**
- KIT Department of Mechanical Engineering

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

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

### Exams

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### Competence Certificate

The assessment consists of an oral exam (20min) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulations.

### Prerequisites

none

### Recommendation

Knowledge out of "Basics of Technical Logistics I" (T-MACH-109919) preconditioned.

---

**Elements and systems of Technical Logistics**

2117096, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Cancelled

---

### Organizational issues

Die Vorlesung wird ab SS 2022 in stark überarbeiteter Form angeboten werden.

Für die bisherige Veranstaltung werden weiterhin Prüfungen zu den üblichen Terminen angeboten.

Die Erfolgskontrolle erfolgt in Form einer mündlichen (20min.) Prüfung (nach §4 (2), 2 SPO). Die Prüfung wird in jedem Semester angeboten und kann zu jedem ordentlichen Prüfungstermin wiederholt werden.

siehe auch Homepage / ILIAS

This lecture will be offered in a deeply restructured form in SS 2022

Assessment for the former lecture is provided also in the future at the regular times

The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulations.

look also at our homepage / ILIAS
7 COURSES
Course: Elements and Systems of Technical Logistics - Project [T-MACH-108946]

7.58 Course: Elements and Systems of Technical Logistics - Project [T-MACH-108946]

Responsible: Georg Fischer
Dr.-Ing. Martin Mittwollen
Organisation: KIT Department of Mechanical Engineering

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

<table>
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Events

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

Competence Certificate
Presentation of performed project and defense (30min) according to $4 (2), No. 3 of the examination regulation

Prerequisites
T-MACH-102159 (Elements and Systems of Technical Logistics) must have been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-102159 - Elements and Systems of Technical Logistics must have been started.

Recommendation
Knowledge out of "Basics of Technical Logistics I" (T-MACH-109919) preconditioned.

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

Elements and systems of Technical Logistics - project
2117097, WS 21/22, SWS, Language: German, Open in study portal

Organizational issues
Das Projekt (als Ergänzung zur Vorlesung) wird ab SS 2022 in stark überarbeiteter Form angeboten werden.
Für die bisherige Veranstaltung werden weiterhin Prüfungen zu den üblichen Terminen angeboten.
Die Erfolgskontrolle erfolgt in Form einer mündlichen (20min.) Prüfung (nach §4 (2), 2 SPO).
Die Prüfung wird in jedem Semester angeboten und kann zu jedem ordentlichen Prüfungstermin wiederholt werden.
siehe auch Homepage / ILIAS
This project (as complement to the lecture) will be offered in a deeply restructured form in SS 2022
Assessment for the former lecture is provided also in the future at the regular times
The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulations.
look also at our homepage / ILIAS
7.59 Course: Energy Efficient Intralogistic Systems [T-MACH-105151]

**Responsible:** Dr.-Ing. Meike Braun  
Dr. Frank Schönung  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:**  
M-MACH-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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**Events**

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<td>Lecture / 🗣</td>
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</table>

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

**Competence Certificate**
Oral, 30 min. examination dates after the end of each lesson period.

**Prerequisites**
none

**Recommendation**
The content of course "Basics of Technical Logistics I" (T-MACH-109919) should be known.

**Annotation**
Visit the IFL homepage of the course for the course dates and/or possible limitations of course participation.

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

**Energy efficient intralogistic systems**

<table>
<thead>
<tr>
<th>Events</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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**Content**
The content of course "Basics of Technical Logistics" should be known.

**Organizational issues**
Termine und Hinweise siehe Homepage / Aushang

**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 | Credits | Grading scale | Recurrence | Version |
-----|---------|---------------|------------|---------|
Oral examination | 4 | Grade to a third | Each winter term | 2 |

Events

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<tr>
<th>Type</th>
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<tr>
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</tr>
<tr>
<td>Exam</td>
<td>Dagan</td>
<td></td>
</tr>
</tbody>
</table>

Competence Certificate
oral exam, approx. 1/2 hour

Prerequisites
none

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

Content
The course deals with fundamental aspects of renewable energies.

1. The first part deals with the basic concepts of absorbing solar beans, in an efficient manner accounting for the minimization of heat losses. In this context, selective topics on thermodynamics as well as fluid dynamics are introduced. In the second part few applications are discussed and optimizations techniques of solar collectors construction and their heat transfer are presented.
2. The use of solar energy as a source for heat generation is followed by the idea of electricity generation. Introductive aspects of Photovoltaic technologies are illuminated.
3. The last part presents additional regenerative energy sources such as wind and geothermal energy.

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

regular attendance: 34 hours
self-study: 146 hours

Oral examination – as an elective course 30 minutes, in combination with Energiesysteme-II or other courses within the energy courses, as a major course 1 hour

Organizational issues
Die Veranstaltung wird nur online gehalten, falls durch Corona Einschränkungen vorgegeben werden.
## 7.61 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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**Exams**

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</table>

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

**Competence Certificate**

Written documentation of every experiment, certificate of successful attendance, no grading

**Prerequisites**

None

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

### Engine Laboratory

2134001, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Practical course (P)**  
**On-Site**

**Organizational issues**

Voraussichtlich 1. vorlesungsfreie Woche im SS 2021. Wird auf der Homepage und in den Vorlesungen bekannt gegeben

**Literature**

Versuchsbeschreibungen
### 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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<td>Each summer term</td>
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**Type:** Oral examination  
**Credits:** 4  
**Grading scale:** Grade to a third  
**Recurrence:** Each summer term  
**Version:** 1

**Events**

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**Exams**

- **ST 2021:** 2134137, SS 2021, 2 SWS, Language: German, Open in study portal
- **WT 21/22:** 76-T-MACH-105169, Engine Measurement Techniques

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

**Competence Certificate**

- Oral examination, Duration: 0.5 hours, no auxiliary means

**Prerequisites**

- None

**Recommendation**

- T-MACH-102194 Combustion Engines I

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

**Engine measurement techniques**

- 2134137, SS 2021, 2 SWS, Language: German, Open in study portal

**Literature**

1. Grohe, H.: Messen an Verbrennungsmotoren
2. Bosch: Handbuch Kraftfahrzeugtechnik
3. Veröffentlichungen von Firmen aus der Meßtechnik
4. Hoffmann, Handbuch der Meßtechnik
5. Klingenberg, Automobil-Meßtechnik, Band C
**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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**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.

**Competence Certificate**

Written exam, 90 min, graded

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

**Engineering Mechanics I**

2161245, WS 21/22, 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
7 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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Exams

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<td>Böhlke, Langhoff</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

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 2021, 3 SWS, Language: German, Open in study portal
Lecture (V) Blended (On-Site/Online)

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 2021, 3 SWS, Language: English, [Open in study portal]

<table>
<thead>
<tr>
<th>Content</th>
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<tbody>
<tr>
<td>• bending</td>
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<tr>
<td>• shear</td>
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<tr>
<td>• torsion</td>
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<tr>
<td>• stress and strain state in 3D</td>
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<tr>
<td>• Hooke's law in 3D</td>
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<tr>
<td>• elasticity theorems in 3D</td>
</tr>
<tr>
<td>• energy methods in elastostatics</td>
</tr>
<tr>
<td>• approximation methods</td>
</tr>
<tr>
<td>• stability of elastic bars</td>
</tr>
</tbody>
</table>
Course: Engineering Mechanics III & IV [T-MACH-105201]

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

Part of: M-MACH-102572 - Engineering Mechanics

Type: Written examination
Credits: 10
Grading scale: Grade to a third
Recurrence: Each winter term
Version: 2

Events

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Exams

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</table>

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 IV
2162231, SS 2021, 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

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

Engineering Mechanics 4
3162012, SS 2021, 2 SWS, Language: English, Open in study portal

Lecture (V)
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.

**Engineering Mechanics III**
2161203, WS 21/22, 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:

**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.

---

**Engineering Mechanics III (Lecture)**
3161012, WS 21/22, 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

### Competence Certificate

Homework is mandatory.

<table>
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<th>Code/Title</th>
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Legend:  🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
7.67 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

<table>
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<th>Recurrence</th>
<th>Version</th>
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| ST 2021 2166556  
Technical Thermodynamics and Heat Transfer II (Tutorial)  
2 SWS | 0 | pass/fail | Each summer term | 1 |
| ST 2021 3166033  
Technical Thermodynamics and Heat Transfer II (Tutorial)  
2 SWS | 0 | pass/fail | Maas |

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</table>
| ST 2021 76-T-MACH-105288  
Excercises in Technical Thermodynamics and Heat Transfer II  
Maas | 0 | pass/fail | |

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

**Competence Certificate**  
Homework is mandatory.

**Prerequisites**  
none

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

**V** Technical Thermodynamics and Heat Transfer II (Tutorial)  
2166556, SS 2021, 2 SWS, Language: German, **Open in study portal**

**Practice (Ü)**  
Blended (On-Site/Online)

**Content**  
Calculation of thermodynamical problems

**Literature**  
Vorlesungsskriptum  
### 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

<table>
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Legend: 🌐 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ☑️ Cancelled

**Competence Certificate**

Successful solving of all exercises

**Prerequisites**

None

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

**Tribology**

2181114, WS 21/22, 5 SWS, Language: German, [Open in study portal](#)
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, Strieber 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

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

**Responsible:** Dr.-Ing. Jens Gibmeier  
apl. Prof. Dr. Reinhard Schneider

**Organisation:** KIT Department of Mechanical Engineering  
Part of: M-MACH-102819 - Major Field: Materials Science and Engineering

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**Events**

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

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<th>76-T-MACH-107685</th>
<th>Exercises for Materials Characterization</th>
<th>Gibmeier</th>
</tr>
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</table>

**Prerequisites**

T-MACH-110945 – Exercises for Materials Characterization has not been started

**Competence Certificate**

Regular attendance

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

#### Materials Characterization

2174586, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Content**

The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

**Learning objectives:**

The students have fundamental knowledge about methods of material analysis. They have a basic understanding to transfer this fundamental knowledge on problems in engineering science. Furthermore, the students have the ability to describe technical material by its microscopic and submicroscopic structure.

**Organizational issues**

Die Vorlesung wird online (asynchron) stattfinden. Das Skript, Ergänzungsmaterialien und die Aufzeichnung von besprochenen Folien werden über ILIAS verwaltet werden. Die Einschreibung in ILIAS wird bis 30.04.2021 ohne Beschränkung möglich sein. Anschließend ist die Anmeldung nur über Dr.-Ing. Jens Gibmeier möglich. **Im Sommersemester 2021 wird die Vorlesung in Deutsch gehalten.**

The lecture will be online (asynchronous). The lecture notes, supplementary material and the recording of lecture slides with audio track will be managed via ILIAS. The registration will be possible without restriction until 30.04.2021. Subsequently, registration is only possible by direct contacting Dr.-Ing. Jens Gibmeier. In summer term 2021 the lecture will be in German. **The English course will be offered in winter term 2021 (starting in October 2021)**

**Literature**

Vorlesungsskript (will be available at the beginning of the course).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.
7.0 Course: Experimental Dynamics [T-MACH-105514]

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

Part of:
- 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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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate
oral exam, 30 min.

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

Modeled Conditions
The following conditions have to be fulfilled:

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

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

Experimental Dynamics
2162225, SS 2021, 3 SWS, Language: German, Open in study portal

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

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
### 7.71 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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**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

**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.  
standard 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  

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**Events**

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**Exams**

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**Competence Certificate**

oral exam ca. 30 minutes  
no tools or reference materials

**Prerequisites**

none

**Recommendation**

preliminary knowledge in mathematics, mechanics and materials science

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

**Failure of structural materials: deformation and fracture**

2181711, WS 21/22, 3 SWS, Language: German, [Open in study portal](#)
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) of the examination regulation.

Organizational issues

Übungstermine werden in der Vorlesung bekannt gegeben!

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

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

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**Events**

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<th>2181715</th>
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<th>2 SWS</th>
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**Exams**

| ST 2021 | 76-T-MACH-102139 | Failure of Structural Materials: Fatigue and Creep | Gruber, 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:**

### Failure of Structural Materials: Fatigue and Creep

2181715, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**
- Blended (On-Site/Online)
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
7.74 Course: Fatigue of Metallic Materials [T-MACH-105354]

**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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**Competence Certificate**

Oral exam, about 20 minutes

**Prerequisites**

none

**Recommendation**

Basic knowledge in Materials Science will be helpful.

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

**Fatigue of Metallic Materials**

2173585, WS 21/22, 2 SWS, Language: German, [Open in study portal]

**Content**

Introduction: some interesting cases of damage
Cyclic Stress Strain Behaviour
Crack Initiation
Crack Propagation
Lifetime Behaviour under Cyclic Loading
Fatigue of Notched Components
Influence of Residual Stresses
Structural Durability

**learning objectives:**

The students are able to recognise the deformation and the failure behaviour of metallic materials under cyclic loading and to assign it to the basic microstructural processes. They know the sequence and the development of fatigue damages and can evaluate the initiation and the growth of fatigue cracks.

The students can assess the cyclic strength behaviour of metallic materials and components both qualitatively and quantitatively and know the procedures for the assessment of single-stage, multistage and stochastic cyclical loadings. Furthermore, they can take into account the influence of residual stresses.

**requirements:**

none, basic knowledge in Material Science will be helpful

**workload:**

regular attendance: 21 hours
self-study: 99 hours

**Literature**

Ein Manuskript, das auch aktuelle Literaturhinweise enthält, wird in der Vorlesung verteilt.
7.75 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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Exams

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

Competence Certificate
oral exam, 20 min

Prerequisites
none
7.76 Course: Fluid Mechanics 1&2 [T-MACH-105207]

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

Part of: M-MACH-102565 - Fluid Mechanics

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Events

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Exams

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

Competence Certificate

written exam 3 hours

Prerequisites

none

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

Fluid Mechanics I

2154512, SS 2021, 3 SWS, Language: German, Open in study portal

Content

Introduction to the fundamentals of fluid mechanics for students of mechanical engineering and related fields, physics and mathematics. The lecture is complemented by a tutorial.

- Introduction
- Flows in Nature and Technologie
- Fundamentals of Fluid Mechanics
- Properties of Fluids and Characteristic Fluid Regimes
- Fundamental Equations of Fluid Mechanics (Conservation of Mass, Momentum and Energy)
  - Continuity equation
  - Navier-Stokes equations (Euler Equations)
  - Energy equation
- Hydro- und Aerostatics
- Flows without dissipation (lossless)
- Technical Flows with Losses
- Introduction to Similarity Analysis
- Two-Dimensional Viscous Flows
- Integral Form of the Governing Equations
- Introduction to Gas Dynamics
### Literature


### Content

Introduction to the fundamentals of fluid mechanics for students of mechanical engineering and related fields, physics and mathematics. The lecture is complemented by a tutorial.

- Introduction
- Flows in Nature and Technology
- Fundamentals of Fluid Mechanics
- Properties of Fluids and Characteristic Fluid Regimes
  - Fundamental Equations of Fluid Mechanics (Conservation of Mass, Momentum and Energy)
    - Continuity equation
    - Navier-Stokes equations (Euler Equations)
    - Energy equation
- Hydro- und Aerostatics
- Flows without dissipation (lossless)
- Technical Flows with Losses
- Introduction to Similarity Analysis
- Two-Dimensional Viscous Flows
- Integral Form of the Governing Equations
- Introduction to Gas Dynamics

### Literature


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
Course: Fluid Power Systems [T-MACH-102093]

Responsible: Prof. Dr.-Ing. Marcus Geimer
             Felix Pult

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102746 - Compulsory Elective Module
         M-MACH-102838 - Major Field: Energy Converting Engines

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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<td>Fluid Power Systems</td>
<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 21/22, 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
7.78 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>Grade to a third</td>
<td>Each summer term</td>
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</table>

Events

| ST 2021 | 2174575 | Foundry Technology | 2 SWS | Lecture / 🧩 | Wilhelm |

Exams

| ST 2021 | 76-T-MACH-105157 | Foundry Technology | Wilhelm |

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 2021, 2 SWS, Language: German, Open in study portal

Lecture (V) Blended (On-Site/Online)
Content
Moulding and casting processes
Solidifying of melts
Castability
Fe-Alloys
Non-Fe-Alloys
Moulding and additive materials
Core production
Sand reclamation
Design in casting technology
Casting simulation
Foundry Processes

Learning Objectives:
The students know the specific moulding and casting techniques and are able to describe them in detail. The students know the application of moulding and casting techniques concerning castings and metals, their advantages and disadvantages in comparison, their application limits and are able to describe these in detail.
The students know the applied metals and are able to describe advantages and disadvantages as well as the specific range of use.
The students are able, to describe detailed mould and core materials, technologies, their application focus and mould-affected casting defects.
The students know the basics of casting process of any casting parts concerning the above mentioned criteria and are able to describe detailed.

Requirements:
Required: Material Science and Engineering I and II

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

Organizational Issues
Vorlesungstermine: 23.4., 30.4., 7.5., 21.5., 11.6., 18.6., 2.7., 16.7.

Literature
Literaturhinweise werden in der Vorlesung gegeben
Reference to literature, documentation and partial lecture notes given in lecture
Course: Fuels and Lubricants for 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

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

### Events

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### Exams

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<td>Each winter term</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), ⌛ On-Site, ❌ Cancelled

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

**Prerequisites**
one

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

#### Fuels and Lubricants for Combustion Engines

2133108, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Content**
Introduction and basics

- Fuels for Gasoline and Diesel engines
- Hydrogen
- Lubricants for Gasoline and Diesel engines
- Coolants for combustion engines

**Literature**
Skript
7.80 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>Unrau, Bardehle</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**

<table>
<thead>
<tr>
<th>Event Code</th>
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<td>2113814</td>
<td>WS 21/22</td>
<td>Fundamentals for Design of Motor-Vehicles Bodies I</td>
<td>Lecture</td>
<td>1 SWS</td>
<td>Grade to a third</td>
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</tbody>
</table>

**Content**

1. History and design
2. Aerodynamics
3. Design methods (CAD/CAM, FEM)
4. Manufacturing methods of body parts
5. Fastening technology
6. Body in white / body production, body surface

**Learning Objectives:**

The students have an overview of the fundamental possibilities for design and manufacture of motor-vehicle bodies. They know the complete process, from the first idea, through the concept to the dimensioned drawings (e.g. with FE-methods). They have knowledge about the fundamentals and their correlations, to be able to analyze and to judge relating components as well as to develop them accordingly.

**Organizational issues**

Termine, nähere Informationen und eventuelle Terminänderungen: siehe Institutshomepage

Dates and further information will be published on the homepage of the institute

**Literature**

1. Automobiltechnische Zeitschrift ATZ, Friedr. Vieweg & Sohn Verlagsges. mbH, Wiesbaden
2. Automobil Revue, Bern (Schweiz)
3. Automobil Produktion, Verlag Moderne Industrie, Landsberg

Bachelor Program Mechanical Engineering . Date: 15/09/2021

Module Handbook valid from Winter Term 21/22
Course: Fundamentals for Design of Motor-Vehicle Bodies II [T-MACH-102119]

**7.81 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

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**Events**

| ST 2021 | 2114840 | Fundamentals for Design of Motor-Vehicles Bodies II | 1 SWS | Lecture / 🖥 Bardehle |

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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 2021, 1 SWS, Language: German, [Open in study portal](#)

**Lecture (V) Online**

**Content**

1. Body properties/testing procedures
2. External body-parts
3. Interior trim
4. Compartment air conditioning
5. Electric and electronic features
6. Crash tests
7. Project management aspects, future prospects

**Learning Objectives:**

The students know that, often the design of seemingly simple detail components can result in the solution of complex problems. They have knowledge in testing procedures of body properties. They have an overview of body parts such as bumpers, window lift mechanism and seats. They understand, as well as, parallel to the normal electrical system, about the electronic side of a motor vehicle. Based on this they are ready to analyze and to judge the relation of these single components. They are also able to contribute competently to complex development tasks by imparted knowledge in project management.

**Organizational issues**

Voraussichtliche Termine, nähere Informationen und evtl. Änderungen: siehe Institutshomepage.

Scheduled dates, further Information and possible changes of date: see homepage of the institute.

**Literature**

1. Automobiltechnische Zeitschrift ATZ, Friedr. Vieweg & Sohn Verlagsges. mbH, Wiesbaden
2. Automobil Revue, Bern (Schweiz)
3. Automobil Produktion, Verlag Moderne Industrie, Landsberg
Course: Fundamentals in the Development of Commercial Vehicles [T-MACH-111389]

Responsible: Dr. Christof Weber
Organisation: KIT Department of Mechanical Engineering

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

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Events

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<td>Fundamentals in the Development of Commercial Vehicles II</td>
<td>Weber</td>
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Competence Certificate
Oral group examination
Duration: appr. 30 minutes
Auxiliary means: none

Prerequisites
none

Annotation
Fundamentals in the Development of Commercial Vehicles I, WT
Fundamentals in the Development of Commercial Vehicles II, ST

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

Fundamentals in the Development of Commercial Vehicles II
2114844, SS 2021, 1 SWS, Language: German, Open in study portal

Content
1. Gear boxes of commercial vehicles
2. Intermediate elements of the drive train
3. Axle systems
4. Front axles and driving dynamics
5. Chassis and axle suspension
6. Braking System
7. Systems
8. Excursion

Learning Objectives:
The students know the advantages and disadvantages of different drives. Furthermore they are familiar with components, such as transfer box, propeller shaft, powered and non-powered front axle etc. Beside other mechanical components, such as chassis, axle suspension and braking system, also electric and electronic systems are known. Consequently the student are able to analyze and to judge the general concepts as well as to adjust them precisely with the area of application.

Organizational issues
Genaue Termine, nähere Informationen und eventuelle Terminänderungen: siehe Institutshomepage.
Fundamentals in the Development of Commercial Vehicles I
2113812, WS 21/22, 1 SWS, Language: German, Open in study portal

Content
1. Introduction, definitions, history
2. Development tools
3. Complete vehicle
4. Cab, bodyshell work
5. Cab, interior fitting
6. Alternative drive systems
7. Drive train
8. Drive system diesel engine
9. Intercooled diesel engines

Learning Objectives:
The students have proper knowledge about the process of commercial vehicle development starting from the concept and the underlying original idea to the real design. They know that the customer requirements, the technical realisability, the functionality and the economy are important drivers.

The students are able to develop parts and components. Furthermore they have knowledge about different cab concepts, the interior and the interior design process. Consequently they are ready to analyze and to judge concepts of commercial vehicles as well as to participate competently in the commercial vehicle development.

Organizational issues
Termine und Nähere Informationen: siehe Institutshomepage
Dates and further information will be published on the homepage of the institute.

Literature
7.83 Course: Fundamentals in the Development of Commercial Vehicles I [T-MACH-105160]

**Responsible:** Dr. Christof Weber

**Organisation:** KIT Department of Mechanical Engineering

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

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**Events**

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**Exams**

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<td>Fundamentals in the Development of Commercial Vehicles I</td>
<td>Zürn</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 in the Development of Commercial Vehicles I**

2113812, WS 21/22, 1 SWS, Language: German, Open in study portal

**Lecture (V)**

Online

**Content**

1. Introduction, definitions, history
2. Development tools
3. Complete vehicle
4. Cab, bodyshell work
5. Cab, interior fitting
6. Alternative drive systems
7. Drive train
8. Drive system diesel engine
9. Intercooled diesel engines

**Learning Objectives:**

The students have proper knowledge about the process of commercial vehicle development starting from the concept and the underlying original idea to the real design. They know that the customer requirements, the technical realisability, the functionality and the economy are important drivers.

The students are able to develop parts and components. Furthermore, they have knowledge about different cab concepts, the interior and the interior design process. Consequently, they are ready to analyze and to judge concepts of commercial vehicles as well as to participate competently in the commercial vehicle development.

**Organizational issues**

Termine und Nähere Informationen: siehe Institutshomepage

Dates and further information will be published on the homepage of the institute.
Literature
7.84 Course: Fundamentals in the Development of Commercial Vehicles II [T-MACH-105161]

**Responsible:** Dr. Christof Weber

**Organisation:** KIT Department of Mechanical Engineering

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

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| Events       | ST 2021 | 2114844 | Fundamentals in the Development of Commercial Vehicles II | 1 SWS | Lecture / 🖥 | Weber |

| Exams        | ST 2021 | 76-T-MACH-105161 | Fundamentals in the Development of Commercial Vehicles II | Zürn |

*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 in the Development of Commercial Vehicles II**

2114844, SS 2021, 1 SWS, Language: German, [Open in study portal]

**Content**

1. Gear boxes of commercial vehicles
2. Intermediate elements of the drive train
3. Axle systems
4. Front axles and driving dynamics
5. Chassis and axle suspension
6. Braking System
7. Systems
8. Excursion

**Learning Objectives:**

The students know the advantages and disadvantages of different drives. Furthermore they are familiar with components, such as transfer box, propeller shaft, powered and non-powered front axle etc. Beside other mechanical components, such as chassis, axle suspension and braking system, also electric and electronic systems are known. Consequently the student are able to analyze and to judge the general concepts as well as to adjust them precisely with the area of application.

**Organizational issues**

Genaue Termine, nähere Informationen und eventuelle Terminänderungen: siehe Institutshomepage.
Literature
1. HILGERS, M.: Nutzfahrzeugtechnik lernen, Springer Vieweg, ISSN: 2510-1803
**7.85 Course: Fundamentals of Automobile Development I [T-MACH-105162]**

**Responsible:** Hon.-Prof. 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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<td>Principles of Whole Vehicle Engineering I</td>
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**Exams**

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<th>Course Title</th>
<th>Notes</th>
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<tr>
<td>ST 2021</td>
<td>76-T-MACH-105162</td>
<td>Fundamentals of Automobile Development I</td>
<td>Frech, Unrau</td>
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<td>WT 21/22</td>
<td>76-T-MACH-105162</td>
<td>Fundamentals of Automobile Development I</td>
<td>Frech, Unrau</td>
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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:

**Fundamentals of Automobile Development I**

**2113810, WS 21/22, 1 SWS, Language: German, Open in study portal**

**Content**

1. Process of automobile development  
2. Conceptual dimensioning and design of an automobile  
3. Laws and regulations – National and international boundary conditions  
4. Aerodynamical dimensioning and design of an automobile I  
5. Aerodynamical dimensioning and design of an automobile II  
6. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines I  
7. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines II

**Learning Objectives:**

The students have an overview of the fundamentals of the development of automobiles. They know the development process, the national and the international legal requirements that are to be met. They have knowledge about the thermo-management, aerodynamics and the design of an automobile. They are ready to judge goal conflicts in the field of automobile development and to work out approaches to solving a problem.

**Organizational issues**

Termine und nähere Informationen finden Sie auf der Institutshomepage.  
Kann nicht mit Lehrveranstaltung 2113851 kombiniert werden.  
Date and further information will be published on the homepage of the institute.  
Cannot be combined with lecture 2113851.

**Literature**

Skript zur Vorlesung wird zu Beginn des Semesters ausgegeben  
The scriptum will be provided during the first lessons
Principles of Whole Vehicle Engineering I  
2113851, WS 21/22, 1 SWS, Language: English, Open in study portal

Content
1. Process of automobile development
2. Conceptual dimensioning and design of an automobile
3. Laws and regulations – National and international boundary conditions
4. Aero dynamical dimensioning and design of an automobile I
5. Aero dynamical dimensioning and design of an automobile II
6. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines I
7. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines II

Learning Objectives:
The students have an overview of the fundamentals of the development of automobiles. They know the development process, the national and the international legal requirements that are to be met. They have knowledge about the thermo-management, aerodynamics and the design of an automobile. They are ready to judge goal conflicts in the field of automobile development and to work out approaches to solving a problem.

Organizational issues
Termine und nähere Informationen finden Sie auf der Institutshomepage.

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
### 7.86 Course: Fundamentals of Automobile Development II [T-MACH-105163]

**Responsible:** Hon.-Prof. 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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**Type:** Written examination  
**Credits:** 2  
**Grading scale:** Grade to a third  
**Recurrence:** Each summer term  
**Version:** 2

**Events**

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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:**

### Fundamentals of Automobile Development II

2114842, SS 2021, 1 SWS, Language: German, [Open in study portal](#)

**Block (B) Online**

**Content**

1. Application-oriented material and production technology I  
2. Application-oriented material and production technology II  
3. Overall vehicle acoustics in the automobile development  
4. Drive train acoustics in the automobile development  
5. Testing of the complete vehicle  
6. Properties of the complete automobile

**Learning Objectives:**

The students are familiar with the selection of appropriate materials and the choice of adequate production technology. They have knowledge of the acoustical properties of the automobiles, covering both the interior sound and exterior noise. They have an overview of the testing procedures of the automobiles. They know in detail the evaluation of the properties of the complete automobile. They are ready to participate competently in the development process of the complete vehicle.

**Organizational issues**

Vorlesung findet als Blockvorlesung statt.  
Kann nicht mit der Veranstaltung [2114860] kombiniert werden.  
Cannot be combined with lecture [2114860].

**Literature**

Skript zur Vorlesung ist über ILIAS verfügbar.
Principles of Whole Vehicle Engineering II
2114860, SS 2021, 1 SWS, Language: English, Open in study portal

Content
1. Application-oriented material and production technology I
2. Application-oriented material and production technology II
3. Overall vehicle acoustics in the automobile development
4. Drive train acoustics in the automobile development
5. Testing of the complete vehicle
6. Properties of the complete automobile

Learning Objectives:
The students are familiar with the selection of appropriate materials and the choice of adequate production technology. They have knowledge of the acoustical properties of the automobiles, covering both the interior sound and exterior noise. They have an overview of the testing procedures of the automobiles. They know in detail the evaluation of the properties of the complete automobile. They are ready to participate competently in the development process of the complete vehicle.

Organizational issues
Kann nicht mit der Veranstaltung [2114842] kombiniert werden.
Cannot be combined with lecture [2114842].
Raum 219, Geb. 70.04, Campus Ost.
Genaue Termine entnehmen Sie bitte der Institut homepage.
Scheduled dates:
see homepage of the institute.

Literature
Das Skript zur Vorlesung ist über ILIAS verfügbar.
Course: Fundamentals of Catalytic Exhaust Gas Aftertreatment [T-MACH-105044]

**Responsible:** Prof. Dr. Olaf Deutschmann  
Prof. Dr. Jan-Dierk Grunwaldt  
Dr.-Ing. Heiko Kubach  
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

**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, Duration: 25 min., no auxiliary means

**Prerequisites**
none

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

**Fundamentals of catalytic exhaust gas aftertreatment**  
2134138, SS 2021, 2 SWS, Language: German, Open in study portal

**Organizational issues**
Blockvorlesung. Termin und Ort werden auf der Homepage des IFKM und ITCP bekannt gegeben.

**Literature**
Skript, erhältlich in der Vorlesung


**Fundamentals of catalytic exhaust gas aftertreatment**  
2134138, WS 21/22, 2 SWS, Language: German, Open in study portal

**Organizational issues**
Blockvorlesung. Termin und Ort werden auf der Homepage des IFKM und ITCP bekannt gegeben.
Literature
Skript, erhältlich in der Vorlesung

7.88 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-102645 - Major Field: Combustion Engine Techniques  
- 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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<td>Fundamentals of Combustion Engine Technology</td>
<td>2 SWS</td>
<td>Lecture</td>
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**Exams**

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<th>Exams</th>
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**Competence Certificate**

oral exam, 30 min

**Prerequisites**

none

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

**Fundamentals of Combustion Engine Technology**

2133123, WS 21/22, 2 SWS, Language: German, Open in study portal

**Content**

- Fundamentals of engine processes  
- Components of combustion engines  
- Mixture formation systems  
- Gas exchange systems  
- Injection systems  
- Exhaust Gas Aftertreatment Systems  
- Cooling systems  
- Ignition Systems
### 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

#### Type
- Written examination

#### Credits
4

#### Grading scale
Grade to a third

#### Recurrence
Each winter term

#### Version
1

### Events

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<td>WT 21/22</td>
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### Exams

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<td>ST 2021</td>
<td>Fundamentals of Combustion I (Tutorial)</td>
<td>Maas</td>
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#### 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 21/22, 2 SWS, Language: German, Open in study portal**

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

**Content**
- Fundamental concepts and phenomena
- Experimental analysis of flames
- Conservation equations for laminar flat flames
- Chemical reactions
- Chemical kinetics mechanisms
- Laminar premixed flames
- Laminar diffusion flames
- Ignition processes
- NOx formation
- Formation of hydrocarbons and soot

**Literature**

Vorlesungsskript,

#### Fundamentals of Combustion I (Tutorial)

**2165517, WS 21/22, 1 SWS, Open in study portal**

**Practice (Ü)**
Online

**Literature**

- Vorlesungsskript
Fundamentals of Combustion I
3165016, WS 21/22, 2 SWS, Language: English, Open in study portal

Content

- Fundamental concepts and phenomena
- Experimental analysis of flames
- Conservation equations for laminar flat flames
- Chemical reactions
- Chemical kinetics mechanisms
- Laminar premixed flames
- Laminar diffusion flames
- Ignition processes
- NOx formation
- Formation of hydrocarbons and soot

Literature
Vorlesungsskript,
Course: Fundamentals of Combustion II [T-MACH-105325]

T 7.90 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

Type: Oral examination
Credits: 4
Grading scale: Grade to a third
Recurrence: Each summer term
Version: 2

Events

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Exams

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

Competence Certificate

Oral exam, approx. 20 min

Prerequisites

none

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

Fundamentals of combustion II

2166538, SS 2021, 2 SWS, Language: German, Open in study portal

Lecture (V) Online

Content

- Three dimensional Navier-Stokes equations for reacting flows
- Turbulent reactive flows
- Turbulent non-premixed flames
- Turbulent premixed flames
- Combustion of liquid and solid fuels
- Engine knock
- Thermodynamics of combustion processes
- Transport phenomena
- Effects of Combustion Processes on the Atmosphere

Literature

Vorlesungsskript;

Übung zu Grundlagen der technischen Verbrennung II

2166539, SS 2021, 1 SWS, Language: German, Open in study portal

Practice (Ü) Online

Content

Calculation and Simulation of combustion processes

Literature

Skript Grundlagen der technischen Verbrennung (I+II) von Prof. Dr. rer. nat. habil. U. Maas
Fundamentals of Combustion II
3166550, SS 2021, 2 SWS, Language: English, Open in study portal

Lecture (V)
Online

Content
- Three dimensional Navier-Stokes equations for reacting flows
- Turbulent reactive flows
- Turbulent non-premixed flames
- Turbulent premixed flames
- Combustion of liquid and solid fuels
- Engine knock
- Thermodynamics of combustion processes
- Transport phenomena
- Effects of Combustion Processes on the Atmosphere

Organizational issues
Time and location will be announced on the website and at the institute showcase.

Literature
Vorlesungsskript;
### 7.91 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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**Competence Certificate**

Written examination, 90 min  

**Prerequisites**

none

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

**Fundamentals of Energy Technology**

2130927, SS 2021, 3 SWS, Language: German, [Open in study portal](#)

**Content**

The objective of the course is to train the students on state of the art knowledge about the challenging fields of energy industry and the permanent competition between the economical profitability and the long-term sustainability. The students obtain basic knowledge on thermodynamics relevant to the energy sector and comprehensive knowledge on the energy sector: demand, energy types, energy mix, installations for energy production (conventional, nuclear and renewable), transport and energy storage, environmental impact and future tendencies. Students are able to use methods of economic efficiency optimization for the energy sector in a creative way, practice oriented, also specifically trained during the corresponding tutorial. The students are qualified for further training in energy engineering related fields and for (also research-related) professional activity in the energy sector.

The following relevant fields of the energy industry are covered:

- Energy demand and energy situation  
- Energy types and energy mix  
- Basics. Thermodynamics relevant to the energy sector  
- Conventional fossil-fired power plants  
- Combined Cycle Power Plants  
- Cogeneration  
- Nuclear energy  
- Regenerative energies: hydropower, wind energy, solar energy, other energy systems  
- Energy storage  
- Transport of energy  
- Power generation and environment. Future of the energy industry
**Fundamentals of Energy Technology**

3190923, SS 2021, 3 SWS, Language: English, [Open in study portal](#)

**Lecture (V) Online**

**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
### Course: Gasdynamics [T-MACH-105533]

**Responsible:** 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

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

### Events

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### Exams

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

### Competence Certificate

oral exam - 30 minutes

### Prerequisites

none

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

#### Gasdynamics

2154200, WS 21/22, 2 SWS, Language: English, Open in study portal

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

### Content

The student can describe the governing equations of Gas Dynamics and the associated basics in Thermodynamics. He will know different flow phenomena of applied Gas Dynamics. He can calculate compressible flows analytically. He is familiar with the Rankine-Hugoniot curve. They can derive the continuity-, the momentum- and the energy equations in differential form. With the help of the stationary flow filament theory they can calculate the normal shock wave and the associated increase of the entropy along past the shock wave. They are able to calculate the stagnation values of the Gas Dynamical variables and to determine their critical values. The students can apply the flow filament theory for variable cross-sectional areas and can distinguish between the different flow fields inside the Laval nozzle that forms with different boundary conditions. He can calculate the values behind an oblique shock wave and can distinguish between attached and detached shock waves. The student can calculate the Prandtl-Meyer expansion wave.

This lecture covers the following topics:

- Introduction to gas dynamics  
- Numerical and experimental examples  
- Governing equations of gas dynamics  
- The transport equations in differential and integral form  
- Stationary flow filament theory with and without normal shock waves  
- Discussion of the energy equation: Stagnation and critical values  
- Flow filament theory at variable cross-sectional area. Flow inside a Laval nozzle  
- Oblique shock waves, detached shock waves  
- Prandtl-Meyer expansion wave  
- Viscous flows (Fanno flow)

### Literature

7.93 Course: Gear Cutting Technology [T-MACH-102148]

Responsible: Dr.-Ing. 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

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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:

Gear Technology
2149655, WS 21/22, 2 SWS, Language: German, Open in study portal

Content
Based on the gearing theory, manufacturing processes and machine technologies for producing gearings, the needs of modern gear manufacturing will be discussed in the lecture. For this purpose, various processes for various gear types are taught which represent the state of the art in practice today. A classification in soft and hard machining and furthermore in cutting and non-cutting technologies will be made. For comprehensive understanding the processes, machine technologies, tools and applications of the manufacturing of gearings will be introduced and the current developments presented. For assessment and classification of the applications and the performance of the technologies, the methods of mass production and manufacturing defects will be discussed. Sample parts, reports from current developments in the field of research and an excursion to a gear manufacturing company round out the lecture.

Learning Outcomes:
The students ...

• can describe the basic terms of gearings and are able to explain the imparted basics of the gearwheel and gearing theory.
• are able to specify the different manufacturing processes and machine technologies for producing gearings. Furthermore they are able to explain the functional principles and the dis-/advantages of these manufacturing processes.
• can apply the basics of the gearing theory and manufacturing processes on new problems.
• are able to read and interpret measuring records for gearings. are able to make an appropriate selection of a process based on a given application
• can describe the entire process chain for the production of toothed components and their respective influence on the resulting workpiece properties.

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

Organizational issues
Start: 21.10.2021
Literature
Medien:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
7.94 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

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**Events**

| ST 2021 | 2134154 | Large Diesel and Gas Engines for Ship Propulsions | 2 SWS | Lecture / _socket | Weisser |

**Exams**

| ST 2021 | 76-T-MACH-110816 | Großdiesel- und -gasmotoren für Schiffsantriebe | Weisser |

**Legend:** 🖥 Online, 📦 Blended (On-Site/Online), 📣 On-Site, ☑️ Cancelled

**Competence Certificate**

oral exam, 20 minutes

**Prerequisites**

None

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

**V** Large Diesel and Gas Engines for Ship Propulsions

2134154, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**

**Blended (On-Site/Online)**

**Content**

- Introduction and History
- Types of Ships and Propulsion Systems
- Thermodynamic
- Boosting
- Design
- Fuels
- Lubricants
- Injection of liquid Fuels
- Combustions Processes for liquid Fuels
- Injection of Gaseous Fuels
- Combustion Processes for Gaseous Fuels
- Emissions
- Integration of Engines in Ships
- Large Engines in other Applications
### 7.95 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

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#### Events

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

#### Competence Certificate

**Verbally**

- **Duration:** 30 up to 40 minutes

#### Prerequisites

- **none**

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

### Handling Characteristics of Motor Vehicles I

- **2113807, WS 21/22, 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, programme packages for automatically producing of simulation equations), model for handling characteristics (task, motion equations)

3. Tyre behavior: Basics, dry, wet and winter-smooth roadway  

#### Learning Objectives:

The students know the basic connections between drivers, vehicles and environment. They can build up a vehicle simulation model, with which forces of inertia, aerodynamic forces and tyre forces as well as the appropriate moments are considered. They have proper knowledge in the area of tyre characteristics, since a special meaning comes to the tire behavior during driving dynamics simulation. Consequently they are ready to analyze the most important influencing factors on the driving behaviour and to contribute to the optimization of the handling characteristics.

#### Literature


7.96 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 2021, 2 SWS, Language: German, Open in study portal

**Content**

1. Vehicle handling: Bases, steady state cornering, steering input step, single sine, double track switching, slalom, cross-wind behavior, uneven roadway

2. Stability behavior: Basics, stability conditions for single vehicles and for vehicles with trailer

Learning Objectives:

The students have an overview of common test methods, with which the handling of vehicles is gauged. They are able to interpret results of different stationary and transient testing methods. Apart from the methods, with which e.g. the driveability in curves or the transient behaviour from vehicles can be registered, also the influences from cross-wind and from uneven roadways on the handling characteristics are well known. They are familiar with the stability behavior from single vehicles and from vehicles with trailer. Consequently they are ready to judge the driving behaviour of vehicles and to change it by specific vehicle modifications.

**Literature**

7.97 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

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**Exams**

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**Competence Certificate**

Written exam, approx. 3 h

**Prerequisites**

none

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

### Heat and Mass Transfer

3122512, SS 2021, 2 SWS, Language: English, [Open in study portal](#)  
Lecture (V)  
Online

**Content**

- Steady and unsteady heat transfer in homogenous materials; Plates, pipe sections and sperical shells  
- Molecular diffusion in gases; analogies between heat conduction and mass diffusion  
- Convective, forced heat transfer in pipes/channels and around plates and profiles.  
- Convective mass transfer, heat-/mass transfer analogy  
- Multi phase convective heat transfer (condensation, evaporation)  
- Radiative heat transfer

**Organizational issues**

Bitte beachten Sie den Aushang.

**Literature**

- Maas ; Vorlesungsskript "Wärme- und Stoffübertragung"  

### Heat and mass transfer

2165512, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)  
Lecture (V)  
Blended (On-Site/Online)

**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"
- Baehr, H.-D., Stephan, K.: "Wärme- und Stoffübertragung". Springer Verlag, 1993
**7.98 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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**Competence Certificate**

written exam, 60 minutes  
The exams are only offered in German!

**Prerequisites**

none

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

**Human Factors Engineering I: Ergonomics**  
2109035, WS 21/22, 2 SWS, Language: German, **Open in study portal**  
Lecture (V)  
Blended (On-Site/Online)

**Content**

The course "Human Factors Engineering I: Ergonomics" takes place in the first half of the semester, **until 2021/12/10**, on Wednesday and Thursday.  
In the second half of the semester, **beginning with 2021/12/15**, the course "Human Factors Engineering II: Work Organisation" takes place on Wednesday and Thursday.  
Content of teaching:

1. Principles of human work  
2. Behavioural-science data acquisition  
3. Workplace design  
4. Work environment design  
5. Work management  
6. Labour law and advocacy groups

**Learning target:**
The students acquire a basic knowledge in the field of ergonomics:

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

Further on the participants get to know basic methods of behavioral-science data acquisition (e.g. eye-tracking, ECG, dual-task-paradigm).
Organizational issues
In der zweiten Hälfte des Semesters, ab dem 15.12.2021, findet die Veranstaltung "Arbeitswissenschaft II: Arbeitsorganisation" am Mittwoch und Donnerstag statt.
- schriftliche Prüfung
- Die Vorlesung hat einen Arbeitsaufwand von 120 h (=4 LP).

Literature
Die Kursmaterialien stehen auf ILIAS zum Download zur Verfügung.
### 7.99 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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#### Exams

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

**Competence Certificate**
written exam, 60 minutes  
The exams are only offered in German!

**Prerequisites**
none

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

#### Human Factors Engineering II: Work Organisation

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Lecture (V)  
Blended (On-Site/Online)
Content
The course "Human Factors Engineering I: Ergonomics" takes place in the first half of the semester, until 2021/12/10, on Wednesday and Thursday.

In the second half of the semester, beginning with 2021/12/15, the course "Human Factors Engineering II: Work Organisation" takes place on Wednesday and Thursday.

Content of teaching:

1. Fundamentals of work organization
2. Empirical research methods
3. Individual level
   - personnel selection
   - personnel development
   - personnel assessment
   - work satisfaction/motivation
4. Group level
   - interaction and communication
   - management of employees
   - team work
5. Organizational level
   - structural organization
   - process organization
   - production organization

Learning target:
The students gain a first insight into empirical research methods (e.g., experimental design, statistical data evaluation). Particularly, they acquire a basic knowledge in the field of work organisation:

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

Organizational issues

In der zweiten Hälfte des Semesters, ab dem 15.12.2021, findet die Veranstaltung "Arbeitswissenschaft II: Arbeitsorganisation" am Mittwoch und Donnerstag statt.

- schriftliche Prüfung
- Die Vorlesung hat einen Arbeitsaufwand von 120 h (=4 LP).

Literature
Die Kursmaterialien stehen auf ILIAS zum Download zur Verfügung.
7.100 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.
# 7.101 Course: Human-Machine-Interaction Pass [T-INFO-106257]

**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
7.102 Course: Hybrid and Electric Vehicles [T-ETIT-100784]

**Responsible:** Dr.-Ing. Klaus-Peter Becker

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

**Part of:**
- M-MACH-102812 - Major Field: Powertrain Systems
- M-MACH-102818 - Major Field: Vehicle Technology
- M-MACH-102820 - Major Field: Mechatronics

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**Prerequisites**

none
### 7.103 Course: Hydraulic Fluid Machinery [T-MACH-105326]

**Responsible:** Dr. Balazs Pritz  
**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

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

**Competence Certificate**

oral exam, 40 min.

**Prerequisites**

None.

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

**V Hydraulic Fluid Machinery**  
2157432, SS 2021, 4 SWS, Language: German, Open in study portal  
Lecture (V) Blended (On-Site/Online)
Content

1. Introduction
2. Basic equations
3. System analysis
4. Elementary Theory (Euler's equation of Fluid Machinery)
5. Operation and Performance Characteristics
6. Similarities, Specific Values
7. Control technics
8. Wind Turbines, Propellers
9. Cavitation
10. Hydrodynamic transmissions and converters

2157432 (Hydraulic Machinery) can not be combined with the event 2157451 (Wind and Hydropower)

Recommendations:
2153412 Fluid mechanics

Students get to know the basics of hydraulic fluid machinery (pumps, fans, hydroturbines, windturbines, hydrodynamic transmissions) in general. Application of the knowledge in different fields of engineering.

The lecture introduces the basics of Hydraulic Fluid Machinery. The different types and shapes are presented. The basic equations for the preservation of mass, momentum and energy are discussed. Velocity schemes in typical cascades are shown, the Euler equation of fluid machinery and performance characteristics are deduced.

Similarities and dimensionless parameters are discussed. Fundamental aspects of operation and cavitation are shown.

Students are able to understand the working principle of Hydraulic Fluid Machinery as well as the interaction with typical systems, in which they are integrated.

regular attendance: 56 hours
self-study: 150 hours
preparation for exam: 40 hours

Oral or written examination (see announcement)
No tools or reference materials may be used during the exam.

Literature

1. Fister, W.: Fluidenergiemaschinen I & II, Springer-Verlag
2. Bohl, W.: Strömungsmaschinen I & II. Vogel-Verlag
5. Carolus, T.: Ventilatoren, Teubner-Verlag
6. Kreiselpumpenlexikon. KSB Aktiengesellschaft
7.104 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

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**Competence Certificate**  
oral exam, appr. 25 minutes, no auxiliary means

**Prerequisites**  
none
7.105 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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Exams

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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
2123900, SS 2021, 4 SWS, Language: German, Open in study portal
Project (PRO)
Blended (On-Site/Online)

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

Organizational issues
Siehe Homepage zur Lehrveranstaltung

Literature
Keine / None

I4.0 Systems platform
2123900, WS 21/22, 4 SWS, Language: German, Open in study portal
Prüfung (PR)
Blended (On-Site/Online)
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
7.106 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

**Type:** Oral examination

**Credits:** 4

**Grading scale:** Grade to a third

**Version:** 1

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**Competence Certificate**
oral exam, 20 min

**Prerequisites**
none

---

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

**Ignition systems**
2133125, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Legend:** 🖥 Online, 📱 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

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

**Industrial aerodynamics**

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

### Competence Certificate
oral exam - 30 minutes

### Prerequisites
none

**Content**

This compact lecture deals with flows and aeroacoustics with significance in vehicle development. A special focus is set on the optimization of external vehicle aerodynamics and the presentation of modern industrial wind tunnel technology. The second major thematic block includes both, aeroacoustic basics principles and practical examples of aeroacoustics, especially in the field of automotive technology. These fields are explained in their phenomenology, the corresponding theories are discussed and the tools for measurement and simulation are introduced and demonstrated. This lecture focusses on industry relevant methods for analyses and descriptions of forces, aeroacoustic sound fields, flow structures and turbulence. In addition, an overview of numerical methods for industrial applications is given. The integration and interconnection of the methods in the development processes are discussed exemplary.

An excursion to the Mercedes-Benz AG wind tunnel and the research and development centers is planned.

- Introduction
- Aerodynamics of bluff bodies
- Industrial flow measurement techniques and modern wind tunnel technology
- Overview of flow simulation in automotive industry
- Vehicle aerodynamics
- Passenger comfort of roadsters and cabriolets
- Soiling of road vehicles
- Aeroacoustics: basic principles and practical examples of aeroacoustics, especially in the field of automotive technology including aeroacoustic measurement techniques and numerical methods

Students can describe the different properties of aerodynamics and aeroacoustics of vehicles flows. They are qualified to analyze external flows around the vehicles and aeroacoustic sound fields of vehicles.

### Organizational issues
Blockvorlesung - Die Anmeldung im Sekretariat ist bis zum 11.02.2022 erforderlich

### Literature
Vorlesungsskript
# 7.108 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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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 2021, 2 SWS, Language: German/English, Open in study portal  
Blended (On-Site/Online)

**Content**  
Seminar papers on current research topics of the Institute for Information Management in Engineering. The respective topics are presented at the beginning of each semester.

**Organizational issues**  
Siehe ILIAS-Kurs

**Literature**  
Themenspezifische Literatur
### 7.109 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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7 COURSES

Course: Information Systems and Supply Chain Management [T-MACH-102128]

7.110 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>Information Systems in Logistics and Supply Chain Management</td>
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<td>Each summer term</td>
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**Exams**

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Legend: 📲 Online, 🧩 Blended (On-Site/Online), 🗼 On-Site, ✗ Cancelled

**Competence Certificate**
The success control takes place in form of a written examination (60 min) during the semester break (according to §4(2), 1 SPO). If the number of participants is low, an oral examination (according to §4 (2), 2 SPO) may also be offered.

**Prerequisites**
none

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

**Information Systems in Logistics and Supply Chain Management**

2118094, SS 2021, 2 SWS, Language: German, Open in study portal

**Literature**

# 7.111 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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**Exams**

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</table>

**Competence Certificate**  
Oral examination 20 min.

**Prerequisites**  
None

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

## Integrated Information Systems for engineers  
2121001, SS 2021, 3 SWS, Language: German, Open in study portal  
Lecture / Practice (VÜ)  
Online

**Content**

- Information systems, information management  
- CAD, CAP and CAM systems  
- PPS, ERP and PDM systems  
- Knowledge management and ontology  
- Process modeling

**Students can:**

- illustrate the structure and operating mode of information systems  
- describe the structure of relational databases  
- describe the fundamentals of knowledge management and its application in engineering and deploy ontology as knowledge representation  
- describe different types of process modelling and their application and illustrate and execute simple work flows and processes with selected tools  
- explain different goals of specific IT systems in product development (CAD, CAP, CAM, PPS, ERP, PDM) and assign product development processes

**Literature**  
Vorlesungsfolien / lecture slides
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
7.112 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 2021 | 2150660 | Integrated Production Planning in the Age of Industry 4.0 | 6 SWS | Lecture / Practice (VÜ) | Lanza |

**Exams**

| ST 2021 | 76-T-MACH-108849 | Integrated Production Planning in the Age of Industry 4.0 | Lanza |

**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 2021, 6 SWS, Language: German, Open in study portal

Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗾 On-Site, ✗ Cancelled
Content
Integrated production planning in the age of industry 4.0 will be taught in the context of this engineering science lecture. In addition to a comprehensive introduction to Industry 4.0, the following topics will be addressed at the beginning of the lecture:

- Basics, history and temporal development of production
- Integrated production planning and integrated digital engineering
- Principles of integrated production systems and further development with Industry 4.0

Building on this, the phases of integrated production planning are taught in accordance with VDI Guideline 5200, whereby special features of parts production and assembly are dealt with in the context of case studies:

- Factory planning system
- Definition of objectives
- Data collection and analysis
- Concept planning (structural development, structural dimensioning and rough layout)
- Detailed planning (production planning and control, fine layout, IT systems in an industry 4.0 factory)
- Preparation and monitoring of implementation
- Start-up and series support

The lecture contents are rounded off by numerous current practical examples with a strong industry 4.0 reference. Within the exercises the lecture contents are deepened and applied to specific problems and tasks.

Learning Outcomes:
The students …

- can discuss basic questions of production technology.
- are able to apply the methods of integrated production planning they have learned about to new problems.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques they have learned about for a specific problem.
- can apply the learned methods of integrated production planning to new problems.
- can use their knowledge targeted for efficient production technology.

Workload:
MACH:
regular attendance: 63 hours
self-study: 177 hours

WING:
regular attendance: 63 hours
self-study: 207 hours

Organizational issues
Vorlesungstermine dienstags 14.00 Uhr und donnerstags 14.00 Uhr, Übungstermine donnerstags 15.45 Uhr. Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung

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

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
## 7.113 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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### Exams

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</tr>
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</table>

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

### Competence Certificate

Written Exam (60 min)

### Prerequisites

none

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

**Integrative Strategies in Production and Development of High Performance Cars**  
Lecture (V)  
2150601, SS 2021, 2 SWS, Language: German, [Open in study portal](#)
Content
The lecture deals with the technical and organizational aspects of integrated development and production of sports cars on the example of Porsche AG. The lecture begins with an introduction and discussion of social trends. The deepening of standardized development processes in the automotive practice and current development strategies follow. The management of complex development projects is a first focus of the lecture. The complex interlinkage between development, production and purchasing are a second focus. Methods of analysis of technological core competencies complement the lecture. The course is strongly oriented towards the practice and is provided with many current examples.

The main topics are:

- Introduction to social trends towards high performance cars
- Automotive Production Processes
- Integrative R&D strategies and holistic capacity management
- Management of complex projects
- Interlinkage between R&D, production and purchasing
- The modern role of manufacturing from a R&D perspective
- Global R&D and production
- Methods to identify core competencies

Learning Outcomes:
The students …

- are capable to specify the current technological and social challenges in automotive industry.
- are qualified to identify interlinkages between development processes and production systems.
- are able to explain challenges and solutions of global markets and global production of premium products.
- are able to explain modern methods to identify key competences of producing companies.

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

Organizational issues
Die Vorlesung wird wöchentlich dienstags, 10:00 – 11:30 Uhr per Zoom stattfinden.
Alle weiteren Informationen inkl. Link zur Zoom-Vorlesung finden Sie im ILIAS-Kurs.

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

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
7 COURSES

Course: Intellectual Property Rights and Strategies in Industrial Companies [T-MACH-105442]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-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

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**Type**
- Oral examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each term

**Version**
- 1

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**Events**

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

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**Competence Certificate**

oral exam (20 min)

**Prerequisites**

none

**Recommendation**

None

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

**Patents and Patentstrategies in innovative companies**

2147160, SS 2021, 2 SWS, Language: German, Open in study portal
Content

Attendance at lectures (5 L): 24h

Personal preparation and follow-up of lecture and exercise: 5h

Preparation exam: 31h

The students understand and are able to describe the basics of intellectual property, particularly with regard to the filing and obtaining of property rights. They can name the criteria of project-integrated intellectual property management and strategic patenting in innovative companies. Students are also able to describe the key regulations of the law regarding employee invention and to illustrate the challenges of intellectual properties with reference to examples.

The lecture will describe the requirements to be fulfilled and how protection is obtained for patents, design rights and trademarks, with a particular focus on Germany, Europe and the EU. Active, project-integrated intellectual property management and the use of strategic patenting by technologically oriented companies will also be discussed. Furthermore, the significance of innovations and intellectual property for both business and industry will be demonstrated using practical examples, before going on to consider the international challenges posed by intellectual property and current trends in the sector. Within the context of licensing and infringement, insight will be provided as to the relevance of communication, professional negotiations and dispute resolution procedures, such as mediation for example. The final item on the agenda will cover those aspects of corporate law that are relevant to intellectual property.

Lecture overview:

1. Introduction to intellectual property
2. The profession of the patent attorney
3. Filing and obtaining intellectual property rights
4. Patent literature as a source of knowledge and information
5. The law regarding employee inventions
6. Active, project-integrated intellectual property management
7. Strategic patenting
8. The significance of intellectual property
9. International challenges and trends
10. Professional negotiations and dispute resolution procedures
11. Aspects of corporate law

Organizational issues

Weitere Informationen siehe IPEK-Homepage.

https://www.ipek.kit.edu/2976_2858.php
7.115 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

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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 21/22, 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**

7.116 Course: Introduction into the Multi-Body Dynamics [T-MACH-105209]

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

### Part of:
- M-MACH-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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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:

**Introduction into the multi-body dynamics**

2162235, SS 2021, 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  
de Ja'lon, J. G., Bayo, E.: Kinematik and Dynamic Simulation of Multibody Systems.  
Kane, T.: Dynamics of rigid bodies.
Course: Introduction to Ceramics [T-MACH-100287]

Responsible: Prof. Dr. Michael Hoffmann
Organisation: KIT Department of Mechanical Engineering

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

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Exams

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Competence Certificate

The assessment consists of an oral exam (30 min) taking place at a specific date.
The re-examination is offered at a specific date.

Prerequisites

None

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

Introduction to Ceramics

2125757, WS 21/22, 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
### 7.118 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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**Exams**

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**Competence Certificate**

written 90min

**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:**

**Introduction to Computational Fluid Dynamics**

2154533, SS 2021, 2 SWS, Language: German, Open in study portal

**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.

**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.
7.119 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 2021   | 2194724 | Introduction to High Temperature Materials | 2 SWS | Lecture / Gorr |

Exams

| ST 2021   | 76-T-MACH-111258 | Introduction to High Temperature Materials | 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

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
Ort: online per MS Teams oder per Zoom
Anmeldung verbindlich bis zum 08.04.2021 unter bronislava.gorr@kit.edu
Nach der Anmeldung wird Ihnen der Link zur Vorlesung per E-Mail am 09.04.2021 mitgeteilt.
Termin: montags, 9:00-10:30 Uhr
Course: Introduction to High Temperature Materials [T-MACH-111258]

Literature

- J. Young, High temperature oxidation and corrosion of metals, Elsevier, 2008
- Skript in elektronischer Form verfügbar.
7.120 Course: Introduction to Nonlinear Vibrations [T-MACH-105439]

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104442 - Major Field: Vibration Theory

**Events**

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

**Prerequisites**  
none

**Recommendation**  
Vibration theory, Mathematical Methods of Vibration Theory, Dynamic Stability

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

**Introduction to Nonlinear Vibrations**  
2162247, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)  
Lecture (V)  
Blended (On-Site/Online)

**Content**

- dynamic systems  
- basic ideas of asymptotic methods  
- perturbation methods: Linstedt-Poincare, averaging, multiple scales  
- limit cycles  
- nonlinear resonance  
- basics of the bifurcation analysis, bifurcation diagrams  
- types of bifurcations  
- discontinuous systems  
- dynamic chaos
Literature


Introduction into the nonlinear vibrations (Tutorial)
2162248, WS 21/22, 2 SWS, Language: German, Open in study portal

Practice (Ü)

Content

Exercises related to the lecture
7.121 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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Exams

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

Competence Certificate
oral exam, 30 min

Prerequisites
none

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

V Introduction to Nuclear Energy
2189903, WS 21/22, 2 SWS, Language: German, Open in study portal

Content
This lecture is dedicated to students of mechanical engineering and other engineering Bachelor or Master degree courses. Goal of the lecture is the fundamental knowledge of nuclear energy and nuclear reactors. After the lecture the students understand the principle of the usage of nuclear energy, the structure and operation of nuclear power plants and nuclear safety measures. Furthermore, the students are capable of giving technical assessment of the usage of nuclear energy with respect to its safety and sustainability.
Course: Introduction to Numerical Fluid Dynamics [T-MACH-105515]

Responsible: Dr. Balazs Pritz
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102838 - Major Field: Energy Converting Engines

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Exams

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<td>Pritz</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Prerequisites
none

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

**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
7.123 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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</table>

**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:**

**Introduction to the Finite Element Method**
2162282, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**

- introduction and motivation, elements of tensor calculus
- Discrete FEM: systems of bars and springs
- Formulations of boundary value problems (1D)
- Approximations in FEM
- FEM for scalar and vector-valued field problems
- Solution methods for linear systems of equations
Literature

- Fish, J., Belytschko, T.: A First Course in Finite Elements, Wiley 2007
### 7.124 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

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#### Events

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#### Exams

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**Legends:**  
- Online  
- Blended (On-Site/Online)  
- On-Site  
- Cancelled

#### Competence Certificate

The success control takes place in form of a written examination during the semester break (according to §4(2), 1 SPO). If the number of participants is low, an oral examination (according to §4 (2), 2 SPO) may also be offered.

#### Prerequisites

none

#### Annotation

1) Detailed script can be downloaded online (www.tup.com), updated and enhanced annually.

2) CD-ROM with chapters and exercises at the end of the semester available from the lecturer, also updated and enhanced annually.

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

**IT-Fundamentals of Logistics: Opportunities for Digital Transformation**  
2118184, SS 2021, 2 SWS, Language: German, Open in study portal

Lecture (V)  
Blended (On-Site/Online)
7.125 Course: Lab Computer-Aided Methods for Measurement and Control [T-MACH-105341]

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

Part of: M-MACH-102817 - Major Field: Information Technology

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Exams

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Competence Certificate

Colloquia

Prerequisites

none

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

Lab Computer-aided methods for measurement and control

2137306, WS 21/22, 3 SWS, Language: German, Open in study portal

Practical course (P)

On-Site

Content

Lerninhalt (EN):

1. Digital technology
2. Digital storage oscilloscope and digital spectrum analyzer
3. Supersonic computer tomography
4. Lighting and image acquisition
5. Digital image processing
6. Image interpretation
7. Control synthesis and simulation
8. Robot: Sensors
9. Robot: Actuating elements and path planning

The lab comprises 9 experiments.

Voraussetzungen: Recommendations:

Basic studies and preliminary examination; basic lectures in automatic control

Arbeitsaufwand (EN): 120 hours

Lernziele (EN):

Powerful and cheap computation resources have led to major changes in the domain of measurement and control. Engineers in various fields are nowadays confronted with the application of computer-aided methods. This lab tries to give an insight into the modern domain of measurement and control by means of practically oriented and flexible experiments. Based on experiments on measurement instrumentation and digital signal processing, elementary knowledge in the domain of visual inspection and image processing will be taught. Thereby, commonly used software like MATLAB/Simulink will be used in both simulation and realization of control loops. The lab closes with selected applications, like control of a robot or supersonic computer tomography.

Nachweis (EN):

Colloquia
Literature
Übungsanleitungen sind auf der Institutshomepage erhältlich.
Instructions to the experiments are available on the institute's website
### 7.126 Course: Laboratory Exercise in Energy Technology [T-MACH-105331]

**Responsible:**
- Prof. Dr.-Ing. Hans-Jörg Bauer
- Prof. Dr. Ulrich Maas
- Dr.-Ing. Heinrich Wirbser

**Organisation:**
KIT Department of Mechanical Engineering

**Part of:**
M-MACH-102816 - Major Field: Fundamentals of Energy Technology

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**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>SWS</th>
<th>Type</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>2171487</td>
<td>Laboratory Exercise in Energy Technology</td>
<td>3</td>
<td>Practical course</td>
<td>On-Site</td>
</tr>
</tbody>
</table>
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

Laboratory Exercise in Energy Technology
2171487, WS 21/22, 3 SWS, Language: German/English, Open in study portal
Content
Online registration within the first two weeks of the lecture period at: http://www.its.kit.edu

- Micro gas turbine
- Several test rigs for the investigation of heat transfer at thermally high loaded components
- Optimization of components of the internal air and oil system
- Characterization of spray nozzles
- Investigation of pollutant and noise emission as well as reliability and material deterioration
- Exhaust gas treatment
  - Exhaust gas turbocharger
  - Cooling Tower
  - 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
Praktika finden in Präsenz statt, sofern die COVID-Inzidenzwerte es zulassen.
7.127 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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<th>Recurrence</th>
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<th>Recurrence</th>
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<tr>
<td>ST 2021</td>
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<td>Practical course</td>
<td>Each term</td>
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<td>Schneider, Pfleging</td>
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<tr>
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<td>Laboratory &quot;Laser Materials Processing&quot;</td>
<td>Practical course</td>
<td>Each term</td>
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<td>Schneider, Pfleging</td>
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**Exams**

<table>
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<th>Type</th>
<th>Grading scale</th>
<th>Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST 2021</td>
<td></td>
<td>Laboratory Laser Materials Processing</td>
<td></td>
<td>Schneider</td>
</tr>
</tbody>
</table>

**Competence Certificate**
The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

**Prerequisites**
None

**Recommendation**
Basic knowledge of physics, chemistry and material science is assumed.

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

| Laboratory "Laser Materials Processing" | Practical course |  
|----------------------------------------|------------------|---
| 2183640, SS 2021, 3 SWS, Language: German | (P) Blended (On-Site/Online) |
The laboratory comprises 8 half-day experiments, which address the following laser processing topics of metals, ceramics and polymers:

- safety aspects
- surface hardening and remelting
- melt and reactive cutting
- surface modification by dispersing or alloying
- welding
- surface texturing
- metrology

There are used CO2-, excimer-, Nd:YAG- and high power diode-laser sources within the laboratory.

The student can describe the influence of laser, material and process parameters and can choose suitable parameters for the most important methods of laser-based processing in automotive engineering.

- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

The attendance to one of the courses Physical Basics of Laser Technology (2181612) or Laser Application in Automotive Engineering (2182642) is strongly recommended.

regular attendance: 34 hours
self-study: 86 hours

The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Organizational issues
Bereits ausgebucht!
Anmeldung per Email an johannes.schneider@kit.edu
Das Praktikum findet in Kleingruppen am IAM-CMS (CS) bzw. IAM-AWP (CN) statt!
Die Termine werden zu Beginn des Semesters bekannt gegeben.

Literature
R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer

Laboratory "Laser Materials Processing"
2183640, WS 21/22, 3 SWS, Language: German, Open in study portal
Practical course (P) Blended (On-Site/Online)
Content
The laboratory comprises 8 half-day experiments, which address the following laser processing topics of metals, ceramics and polymers:

• safety aspects
• surface hardening and remelting
• melt and reactive cutting
• surface modification by dispersing or alloying
• welding
• surface texturing
• metrology

There are used CO2-, excimer-, Nd:YAG- and high power diode-laser sources within the laboratory.

The student

• can describe the influence of laser, material and process parameters and can choose suitable parameters for the most important methods of laser-based processing in automotive engineering.
• can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

The attendance to one of the courses Physical Basics of Laser Technology (2181612) or Laser Application in Automotive Engineering (2182642) is strongly recommended.

regular attendance: 34 hours
self-study: 86 hours

The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Organizational issues
Maximal 12 Teilnehmer/innen!
Aktuell sind bereist alle Plätze vergeben! Registrierung für Nachrückliste möglich per Email an johannes.schneider@kit.edu
Praktikum findet in Kleingruppen semesterbegleitend (dienstags bzw. mittwochs, ganztägig) bzw. als Blockpraktikum auf dem Campus Nord am IAM-AWP (Geb. 681) und auf dem Campus Süd am IAM-CMS (Geb. 30.48) statt!
Termine werden mit den Teilnehmern/innen direkt abgestimmt.

Literature
R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer
7 COURSES

7.128 Course: Laboratory Mechatronics [T-MACH-105370]

Responsible: Prof. Dr. Veit Hagenmeyer
Prof. Dr.-Ing. Wolfgang Seemann
Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102815 - Major Field: Engineering Design
M-MACH-102817 - Major Field: Information Technology
M-MACH-102820 - Major Field: Mechatronics

Events

<table>
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<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<td>pass/fail</td>
<td>Each winter term</td>
<td>4</td>
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</table>

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
2105014, WS 21/22, 3 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content

Part I
- Control, programming and simulation of robots
- CAN-Bus communication
- Image processing / machine vision
- Dynamic simulation of robots in ADAMS

Part II
- Solution of a complex problem in team work

Learning objectives:
The student is able to ...

- use his knowledge about mechatronics and microsystems technology to solve a practical problem. The laboratory course comprises simulation, bus communication, measurement instrumentation, control engineering and programming.
- integrate the different subsystems from a manipulator to a working compound system in teamwork.

Nachweis (EN): certificate of successful attendance
Voraussetzung (EN): none
Arbeitsaufwand (EN):
- regular attendance: 33.5 h
- self-study: 88.5 h
Organizational issues
Das Praktikum ist anmeldepflichtig.
Die Anmeldungsmodalitäten/-fristen werden auf www.iai.kit.edu bekannt gegeben.
Siehe Internet / Aushang Raum 033 EG, im Gebäude 40.32.

Literature
Materialien zum Mechatronik-Praktikum
Manuals for the laboratory course on Mechatronics
7.129 Course: Laboratory Production Metrology [T-MACH-108878]

Responsible: Dr.-Ing. Benjamin Häfner
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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Events

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<td>Laboratory Production Metrology</td>
<td>3 SWS</td>
<td>Practical course / Häfner</td>
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Exams

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<td>Laboratory Production Metrology</td>
<td>Häfner</td>
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</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:

Laboratory Production Metrology

2150550, SS 2021, 3 SWS, Language: German, Open in study portal

Practical course (P) On-Site
Content
During this course, students get to know measurement systems that are used in a production system. In the age of Industry 4.0, sensors are becoming more important. Therefore, the application of in-line measurement technology such as machine vision and non-destructive testing is focussed. Additionally, laboratory based measurement technologies such as computed tomography are addressed. The students learn the theoretical background as well as practical applications for industrial examples. The students use sensors by themselves during the course. Additionally, they are trained on how to integrate sensors in production processes and how to analyze measurement data with suitable software.

The following topics are addressed:

- Classification and examples for different measurement technologies in a production environment
- Machine vision with optical sensors
- Information fusion based on optical measurements
- Robot-based optical measurements
- Non-destructive testing by means of acoustic measurements
- Coordinate measurement technology
- Industrial computed tomography
- Measurement uncertainty evaluation
- Analysis of production data by means of data mining

Learning Outcomes:
The students …

- are able to name, describe and mark out different measurement technologies that are relevant in a production environment.
- are able to conduct measurements with the presented in-line and laboratory based measurement systems.
- are able to analyze measurement results and assess the measurement uncertainty of these.
- are able to deduce whether a work piece fulfills quality relevant specifications by analysing measurement results.
- are able to use the presented measurement technologies for a new task.

Workload:
regular attendance: 31,5 hours
self-study: 88,5 hours

Organizational issues
Die Lehrveranstaltung findet stets dienstags nachmittags statt.


The course always takes place on Tuesdays in the afternoon.

For organizational reasons the number of participants for the course is limited. Hence an 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.
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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<td>Grade to a third</td>
<td>Each summer term</td>
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**Events**

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<th>ST 2021</th>
<th>2182642</th>
<th>Laser in automotive engineering</th>
<th>2 SWS</th>
<th>Lecture</th>
<th>Schneider</th>
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**Exams**

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<tr>
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<th>76-T-MACH-105164</th>
<th>Laser in Automotive Engineering</th>
<th>Schneider</th>
</tr>
</thead>
</table>

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

**Competence Certificate**

oral examination (30 min)

no tools or reference materials

**Prerequisites**

It is not possible, to combine this brick with brick Physical Basics of Laser Technology [T-MACH-109084] and brick Physical Basics of Laser Technology [T-MACH-102102]

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-102102 - Physical Basics of Laser Technology must not have been started.

**Recommendation**

preliminary knowlegde in mathematics, physics and materials science

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

**Laser in automotive engineering**  
2182642, SS 2021, 2 SWS, Language: German, [Open in study portal](#)
Content
Based on a short description of the physical basics of laser technology the lecture reviews the most important high power lasers and their various applications in automotive engineering. Furthermore the application of laser light in metrology and safety aspects will be addressed.

- physical basics of laser technology
- laser beam sources (Nd:YAG-, CO2-, high power diode-laser)
- beam properties, guiding and shaping
- basics of materials processing with lasers
- laser applications in automotive engineering
- economical aspects
- safety aspects

The student
- can explain the principles of light generation, the conditions for light amplification as well as the basic structure and function of Nd:YAG-, CO2- and high power diode-laser sources.
- can describe the most important methods of laser-based processing in automotive engineering and illustrate the influence of laser, material and process parameters.
- can analyse manufacturing problems and is able to choose a suitable laser source and process parameters.
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

It is not possible, to combine this lecture with the lecture Physical basics of laser technology [2181612].

regular attendance: 22.5 hours
self-study: 97.5 hours
oral examination (ca. 30 min)

no tools or reference materials

Organizational issues
Bitte nutzen Sie die Vorlesungsaufzeichnung aus dem SS 19!
Bei Interesse bitte melden bei johannes.schneider@kit.edu!
Aktuelle Infos werden über ILIAS verteilt!

Literature
R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer
7.131 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>
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<th>Events</th>
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<th>Grading scale</th>
<th>Recurrence</th>
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<td>Grade to a third</td>
<td>Each summer term</td>
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**Leadership and Conflict Management (in German)**  
2 SWS Lecture / ✗ Hatzl

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

**Prerequisites**  
none

**Annotation**  
This lecture will also be offered once in winter term 20/21.

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

**Leadership and Conflict Management (in German)**  
2110017, SS 2021, 2 SWS, Language: German, Open in study portal  
Lecture (V) Cancelled

**Content**  
In this compact event, management and leadership techniques are taught which are among the key qualifications for management tasks. Furthermore, you will be prepared for management and leadership tasks.

The course consists of the following course contents:

1. Introduction to the topic  
   - Goal setting and goal achievement  
   - Management techniques in planning  
   - Communication and information  
   - Decision Theory  
   - Leadership and cooperation  
   - Self Management  
   - Conflict management and strategy  
   - Case studies

It passes:

- Obligatory attendance

**Prerequisites:**

- Knowledge of work and economic science is advantageous

**Organizational issues**

Da das ganze Sommersemester 2021 komplett digital stattfinden soll, muss diese Präsenzveranstaltung leider abgesagt werden.

**Literature**

Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.
### 7.132 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>
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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>Type</th>
<th>Lecturer</th>
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<tr>
<td>WT 21/22</td>
<td>2145184</td>
<td>Leadership and Product</td>
<td>2 SWS</td>
<td>Lecture</td>
<td>Ploch</td>
</tr>
</tbody>
</table>

**Competence Certificate**  
oral exam (20 min)

**Prerequisites**  
none

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

#### Leadership and Product Development  
2145184, WS 21/22, 2 SWS, Language: German, [Open in study portal](https://example.de)

**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
### 7.133 Course: Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice [T-MACH-110954]

**Responsible:** Dr.-Ing. Luise Kärger  
Dr.-Ing. Wilfried Liebig  

**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102818 - Major Field: Vehicle Technology

<table>
<thead>
<tr>
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**Events**

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<tbody>
<tr>
<td>WT 21/22</td>
<td>Lecture / Practice (VÜ)</td>
<td>4 SWS</td>
<td></td>
<td>Kärger, Liebig</td>
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</tbody>
</table>

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

**Competence Certificate**
oral exam (about 25 minutes)

**Prerequisites**
none

**Recommendation**
- Materials of Lightweight Construction
- Structural Analysis of Composite Laminates
- Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies

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

#### Lightweight constructions with fiber-reinforced-polymers – theory and practice

2113110, WS 21/22, 4 SWS, Language: German, [Open in study portal](#)
Content
The cooperative educational concept of the FAST-LBT and IAM-WK give students an understanding of theory and practice for lightweight constructing with fiber-reinforced-polymers. Students solve an engineering lightweight task in small groups (max. 4 p.), for example the construction of an optimal bending beam under certain space and weight conditions. Various Materials (fibers, resins, foams, etc.) as well as relevant material data are provided and can be used any arbitrary combination. In a first step, students develop a theoretical solution and verify it simulative. Therefore, an introductory basic lecture teaches the mechanics and simulations techniques of fiber-reinforced-polymers. In a second step the students manufacture specimens based on their theoretical solution at the IAM-WK. The specimens are then tested on bending machines. The students gain knowledge about fiber-reinforced-polymers (materials, manufacturing, manufacturing effects, restrictions, etc.) and structural analysis simulations (modelling, simplifications, assumptions, material models, etc.) as well as material characterization and testing. Building on the basic lecture the knowledge is gained autonomously by solving realistic practice relevant tasks. The main topics are:

- Basics of Lightweight strategies
- Basics of fiber-reinforced-polymers
- Basics of FEM-simulations with anisotropic material systems
- Simulative part analysis
- Manufacturing of fiber-reinforced-polymers
- Mechanical testing

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

Organizational issues
Die Veranstaltung findet Mittwochs von 14:00 - 17:00 Uhr statt - Die Raumbelegung wird zu Beginn des Wintersemesters bekannt gegeben
7.134 Course: Lightweight Engineering Design [T-MACH-105221]

**Responsible:** Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Norbert Burkardt

**Organisation:** KIT Department of Mechanical Engineering

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

**Type**
- Written examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each summer term

**Version**
- 2

### Events

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<th>Code</th>
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<td>Lightweight Engineering Design</td>
<td>Lecture</td>
<td>2 SWS</td>
<td>Grade to a third</td>
<td>Each summer term</td>
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### Exams

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<th>Type</th>
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<td>Lightweight Engineering Design</td>
<td>Lecture</td>
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<td>Lecture</td>
<td>2 SWS</td>
<td>Grade to a third</td>
<td>Each summer term</td>
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**Competence Certificate**
- Written examination (90 min)

**Prerequisites**
- None

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

**Lightweight Engineering Design**
- 2146190, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Content**

General aspects of lightweight design, lightweight strategies, construction methods, design principles, lightweight construction, stiffening techniques, lightweight materials, virtual product engineering, bionics, joining techniques, validation, recycling

Additionally, guest speakers from industry will present lightweight design from an practical point of view.

The students are able to ...

- evaluate the potential of central lightweight strategies and their application in design processes.
- apply different stiffing methods qualitatively and to evaluate their effectiveness.
- evaluate the potential of computer-aided engineering as well as the related limits and influences on manufacturing.
- reflect the basics of lightweight construction from a system view in the context of the product engineering process.
Organizational issues
Vorlesungsfolien können über die eLearning-Plattform ILIAS bezogen werden.
Die Prüfungsart wird gemäß der Prüfungsordnung zu Vorlesungsbeginn angekündigt:

- Schriftliche Prüfung: 90 min Prüfungsdauer
- Mündliche Prüfung: 20 min Prüfungsdauer
- Erlaubte Hilfsmittel: keine

Medien: Beamer

Arbeitsbelastung:

- Präsenzzeit: 21 h
- Selbststudium: 99 h

Lecture slides are available via eLearning-Platform ILIAS.
The type of examination (written or oral) will be announced at the beginning of the lecture:

- written examination: 90 min duration
- oral examination: 20 min duration
- auxiliary means: None

Media: Beamer

Workload:

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

Literature
Klein, B.: Leichtbau-Konstruktion. Vieweg & Sohn Verlag, 2007
7.135 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

<table>
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**Events**

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<td>Machine Dynamics</td>
<td>2</td>
<td>Lecture / 📱</td>
<td>English</td>
<td>Proppe</td>
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<td>ST 2021</td>
<td>2161225</td>
<td>Machine Dynamics (Tutorial)</td>
<td>1</td>
<td>Practice / 📱</td>
<td>English</td>
<td>Proppe, Fischer</td>
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**Exams**

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<th>Language</th>
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<td>Machine Dynamics</td>
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<td>Proppe</td>
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</table>

**Competence Certificate**  
written exam, 180 min.

**Prerequisites**

none

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

**Machine Dynamics**  
2161224, SS 2021, 2 SWS, Language: English, Open in study portal

**Content**

1. Introduction  
2. Machine as mechatronic system  
3. Rigid rotors: equations of motion, transient and stationary motion, balancing  
4. Flexible rotors: Laval rotor (equations of motion, transient and stationary behavior, critical speed, secondary effects), refined models  
5. Slider-crank mechanisms: kinematics, equations of motion, mass and power balancing

**Literature**

Biezeno, Grammel: Technische Dynamik, 2. Aufl., 1953

Holzweißig, Dresig: Lehrbuch der Maschinendynamik, 1979

Dresig, Vulfson: Dynamik der Mechanismen, 1989

**Machine Dynamics (Tutorial)**  
2161225, SS 2021, 1 SWS, Language: English, Open in study portal

**Content**

Exercises related to the lecture
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

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

### Events

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<tr>
<td>ST 2021 2162220</td>
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<td>Lecture / 🖥</td>
<td>Each winter term</td>
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**Exams**

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<td>Lecture / 🖥</td>
<td>Each winter term</td>
<td>Grade to a third</td>
<td>Each winter term</td>
<td>Proppe</td>
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</table>

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

**Prerequisites**
none

**Recommendation**
Machine Dynamics

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

#### Machine Dynamics II

2162220, SS 2021, 2 SWS, Language: English, Open in study portal

**Content**

Students are able to develop and analyze detailed models in machine dynamics that encompass continuum models, fluid structure interaction, and stability analyses.

- hydrodynamic bearings  
  - rotating shafts in hydrodynamic bearings  
  - belt drives  
  - vibration of turbine blades

**Literature**


#### Machine Dynamics II

2162220, WS 21/22, 2 SWS, Language: English, Open in study portal

**Content**

- hydrodynamic bearings  
  - rotating shafts in hydrodynamic bearings  
  - belt drives  
  - vibration of turbine blades

**Literature**

7.137 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

<table>
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<th>Credits</th>
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</table>

**Events**

| WT 21/22 | 2149910 | Machine Tools and High-Precision Manufacturing Systems | 6 SWS | Lecture / Practice ( / Fleischer |
|-----------|---------|------------------------------------------------------|-------|--------------------------------

**Exams**

| ST 2021 | 76-T-MACH-110962 | Machine Tools and High-Precision Manufacturing Systems | Fleischer |

**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.

**Competence Certificate**

Oral exam (40 minutes)

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

**Machine Tools and High-Precision Manufacturing Systems**

2149910, WS 21/22, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
Blended (On-Site/Online)
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/TWWL:
regular attendance: 63 hours
self-study: 207 hours

Organizational issues
Start: 18.10.2021
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.

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

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
7 COURSES

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>
<thead>
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Events

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<tr>
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<th>Code</th>
<th>Type</th>
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<th>Language</th>
<th>Lecturer(s)</th>
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<tr>
<td>WT 21/22</td>
<td>2137308</td>
<td>Machine Vision</td>
<td>4</td>
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<td>Lauer, Kinzig</td>
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Exams

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<th>Code</th>
<th>Type</th>
<th>Language</th>
<th>Lecturer(s)</th>
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<tbody>
<tr>
<td>ST 2021</td>
<td>76-T-MACH-105223</td>
<td>Machine Vision</td>
<td></td>
<td>Stiller, Lauer</td>
</tr>
</tbody>
</table>

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

Competence Certificate

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

Prerequisites

None

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

Machine Vision
2137308, WS 21/22, 4 SWS, Language: English, Open in study portal
Lecture / Practice (VÜ)
Online

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.
7.139 Course: Machines and Processes [T-MACH-105208]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
Dr.-Ing. Heiko Kubach  
Prof. Dr. Ulrich Maas  
Dr. Balazs Pritz

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102566 - Machines and Processes

---

**Type**: Written examination  
**Credits**: 7  
**Grading scale**: Grade to a third  
**Recurrence**: Each term  
**Version**: 2

### Events

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<td>WT 21/22</td>
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<td>Machines and Processes</td>
<td>4 SWS</td>
<td>Lecture / Practice ( / 🧩)</td>
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### Exams

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<th>Type</th>
<th>Credits</th>
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<td>Machines and Processes</td>
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<td>Lecture / Practice ( / 🧩)</td>
<td>Kubach, Bauer, Maas, Pritz</td>
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<td>Lecture / Practice ( / 🧩)</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**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 21/22, 4 SWS, Language: German, Open in study portal  
Lecture / Practice (VÜ)  
Blended (On-Site/Online)
Content
basics of thermodynamics
thermal fluid machines
  • steam turbines
  • gas turbines
  • combined-cycle plants
  • turbines and compressors
  • aircraft engines
hydraulic fluid machines
  • operating performance
  • characterization
  • control
  • cavitation
  • wind turbines, propellers
internal combustion engines
  • characteristic parameters
  • engine parts
  • kinematics
  • engine processes
  • emissions

Organizational issues
Vorlesung/Übung findet in Präsenz statt, sofern es die COVID-Inzidenzwerte zulassen
7 Courses

Course: Machines and Processes, Prerequisite [T-MACH-105232]

7.140 Course: Machines and Processes, Prerequisite [T-MACH-105232]

**Responsible:**
- Prof. Dr.-Ing. Hans-Jörg Bauer
- Dr.-Ing. Heiko Kubach
- Prof. Dr. Ulrich Maas
- Dr. Balazs Pritz

**Organisation:**
KIT Department of Mechanical Engineering

**Part of:**
M-MACH-102566 - Machines and Processes

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**Events**

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<tbody>
<tr>
<td>ST 2021</td>
<td>2187000</td>
<td>Machines and Processes (Lab Course)</td>
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<td>Practical course / 🧩</td>
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<td>Bauer, Kubach, Maas, Pritz</td>
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<td>Practical course / 🔴</td>
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**Exams**

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<td>76-T-MACH-105232</td>
<td>Machines and Processes, Prerequisite</td>
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<td>Kubach, Bauer, Maas, Pritz</td>
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<tr>
<td>WT 21/22</td>
<td>76-T-MACH-105232</td>
<td>Machines and Processes, Prerequisite</td>
<td>1</td>
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<td>Kubach, Maas, Bauer, Gabi</td>
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</table>

**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 (Lab Course)**
2187000, SS 2021, 1 SWS, Language: German, [Open in study portal](#)

**Practical course (P)**
Blended (On-Site/Online)
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.

Laboratory Course Experiment
7.141 Course: Manufacturing Technology [T-MACH-102105]

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

**Organisation:** KIT Department of Mechanical Engineering

| Part of: | M-MACH-102589 - Major Field: Production Systems
| M-MACH-102815 - Major Field: Engineering Design |

<table>
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<th>Credits</th>
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<th>Recurrence</th>
<th>Version</th>
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<td>Each winter term</td>
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**Events**

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<td>2149657</td>
<td>Manufacturing Technology</td>
<td>6</td>
<td>Lecture / Practice</td>
<td>Schulze, Gerstenmeyer</td>
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<td>Manufacturing Technology</td>
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<td>Written Exam</td>
<td>Schulze</td>
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</table>

**Prerequisites**

none

**Competence Certificate**

Written Exam (180 min)

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

**Manufacturing Technology**

2149657, WS 21/22, 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
Start: 18.10.2021

Vorlesungstermine montags und dienstags, Übungstermine mittwochs.
Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung.

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

Media:
Lecture notes will be provided in ilias (https://ilias.studium.kit.edu/).
7.142 Course: Material Flow in Logistic Systems [T-MACH-102151]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102589 - Major Field: Production Systems

<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>
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<td>9</td>
<td>Grade to a third</td>
<td>Each winter term</td>
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**Events**

<table>
<thead>
<tr>
<th>WT 21/22</th>
<th>2117051</th>
<th>Material flow in logistic systems</th>
<th>15 SWS</th>
<th>Others (sons)</th>
<th>Furmans, Klein, Fleischmann</th>
</tr>
</thead>
</table>

**Competence Certificate**

The assessment (Prüfungsleistung anderer Art) consists of the following assignments:

- 40% assessment of the final case study as individual performance,
- 60% semester evaluation which includes working on 5 case studies and defending those (For both assessment types, the best 4 of 5 tries count for the final grade.):
  - 40% assessment of the result of the case studies as group work,
  - 20% assessment of the oral examination during the case study colloquiums as individual performance.

A detailed description of the learning control can be found under Annotations.

**Prerequisites**

none

**Recommendation**

Recommended elective subject: Probability Theory and Statistics

**Annotation**

Students are divided into groups for this course. Five case studies are carried out in these groups. The results of the group work during the lecture period are presented and evaluated in writing. In the oral examination during the case study colloquiums, the understanding of the result of the group work and the models dealt with in the course is tested. The participation in the oral defenses is compulsory and will be controlled. For the written submission the group receives a common grade, in the oral defense each group member is evaluated individually.

After the lecture period, there is the final case study. This case study contains the curriculum of the whole semester. The students work individually on this case study which takes place at a predefined place and time (duration: 4h).

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

**Material flow in logistic systems**

2117051, WS 21/22, 15 SWS, Language: German, Open in study portal
Content

Learning Content:

- Elements of material flow systems (conveyor elements, fork, join elements)
- Models of material flow networks using graph theory and matrices
- Queueing theory, calculation of waiting time, utilization
- Warehousing and order-picking
- Shuttle systems
- Sorting systems
- Simulation
- Calculation of availability and reliability
- Value stream analysis

After successful completion of the course, you are able (alone and in a team) to:

- Accurately describe a material handling system in a conversation with an expert.
- Model and parameterize the system load and the typical design elements of a material handling system.
- Design a material handling system for a task.
- Assess the performance of a material handling system in terms of the requirements.
- Change the main lever for influencing the performance.
- Expand the boundaries of today's methods and system components conceptually if necessary.

Literature:
Arnold, Dieter; Furmans, Kai: Materialfluss in Logistiksystemen; Springer-Verlag Berlin Heidelberg, 7. Auflage 2019

Description:
This course is seperated into 5 topic blocks which are structured in the following parts:
- self-study phase
- exercise
- plenary
- case study (group work)
- colloquium
- review of case study

The groups for the case study will be formed at the beginning of the course (first week). The results of the group work during the lecture period are presented and evaluated in writing. During the colloquiums, the result of the case study is presented and the understanding of the group work and the models dealt with in the course are tested in an oral defense. The participation in the colloquiums is compulsory and will be controlled. For the written submission and the presentation the group receives a common grade, in the oral defense each group member is evaluated individually.

After the lecture period, there is the final case study. This case study contains the curriculum of the whole semester. The students work individually on this case study which takes place at a predefined place and time (duration: 4h).

We strongly recommend to attend the introductory session on 20th of October 2021. In this session, the teaching concept of "Materialfluss in Logistiksysteme" is explained and outstanding issues are clarified.

The course registration including the group allocation with ILIAS is mandatory. The registration will be open for several days after the introductory session (registration duration: 20.10.2021 14:00 Uhr - 26.10.2021 14:00 Uhr)

Workload:

- Regular attendance: 35 h
- Self-study: 135 h
- Group work: 100 h

Competence Certificate:
The assessment (Prüfungsleistung anderer Art) consists of the following assignments:

- 40% assessment of the final case study as individual performance,
- 60% semester evaluation which includes working on 5 case studies and defending those (For both assessment types, the best 4 of 5 tries count for the final grade.):
  - 40% assessment of the result and the presentation of the case studies as group work,
  - 20% assessment of the oral examination during the colloquiums as individual performance.
Course: Materials Characterization [T-MACH-107684]

- **Responsible:** Dr.-Ing. Jens Gibmeier, apl. Prof. Dr. Reinhard Schneider
- **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 summer term

### Version
- 4

#### Events
<table>
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<tr>
<th>Event</th>
<th>Code</th>
<th>Title</th>
<th>Format</th>
<th>Language</th>
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<tr>
<td>ST 2021</td>
<td>2174586</td>
<td>Materials Characterization</td>
<td>Lecture</td>
<td>German</td>
<td>Schneider, Gibmeier</td>
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</table>

#### Exams
<table>
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<tr>
<th>Event</th>
<th>Code</th>
<th>Title</th>
<th>Format</th>
<th>Language</th>
</tr>
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<tbody>
<tr>
<td>ST 2021</td>
<td>76-T-MACH-107684</td>
<td>Materials Characterization</td>
<td>Lecture</td>
<td>German</td>
</tr>
</tbody>
</table>

**Legend:** 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 2021, 2 SWS, Language: German, [Open in study portal](#)

### Content
The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

**learning objectives:**

The students have fundamental knowledge about methods of material analysis. They have a basic understanding to transfer this fundamental knowledge on problems in engineering science. Furthermore, the students have the ability to describe technical material by its microscopic and submicroscopic structure.

### Organizational issues


The lecture will be online (asynchronous). The lecture notes, supplementary material and the recording of lecture slides with audio track will be managed via ILIAS. The registration will be possible without restriction until 30.04.2021. Subsequently, registration is only possible by direct contacting Dr.-Ing. Jens Gibmeier. In summer term 2021 the lecture will be in German. The English course will be offered in winter term 2021 (starting in October 2021)
Literature
Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).
Literatur wird zu Beginn der Veranstaltung bekanntgegeben.
Course: Materials of Lightweight Construction [T-MACH-105211]

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

**Organisation:** KIT Department of Mechanical Engineering

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

<table>
<thead>
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<th>Recurrence</th>
<th>Version</th>
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<td>Grade to a third</td>
<td>Each summer term</td>
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**Events**

<table>
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<tr>
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<th>2174574</th>
<th>Materials of Lightweight Construction</th>
<th>2 SWS</th>
<th>Liebig, Elsner</th>
</tr>
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</table>

**Exams**

<table>
<thead>
<tr>
<th>ST 2021</th>
<th>76-T-MACH-105211</th>
<th>Materials of Lightweight Construction</th>
<th>Liebig</th>
</tr>
</thead>
</table>

Legend: 🛩 Online, 🧩 Blended (On-Site/Online), ⬛ On-Site, ✗ Cancelled

**Competence Certificate**

Oral exam, about 25 minutes

**Prerequisites**

none

**Recommendation**

Materials Science I/II

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

Materials of Lightweight Construction

2174574, SS 2021, 2 SWS, Language: German, Open in study portal

Lecture (V)

Online
Content
Introduction
Constructive, production-orientied and material aspects of lightweight construction

Aluminium-based alloys
Aluminium wrought alloys
Aluminium cast alloys
Magnesium-based alloys
Magnesium wrought alloys
Magnesium cast alloys
Titanium-based alloys
Titanium wrought alloys
Titanium cast alloys
High-strength steels
High-strength structural steels,
Heat-treatable steels, press-hardening and hardenable steels
Composites - mainly PMC
Matrices
Reinforcements
Basic mechanical principles of composites
Hybrid composites
Special materials for lightweight design
Beryllium alloys
Metallic Glasses
Applications

Learning objectives:
The students are capable to name different lightweight materials and can describe their composition, properties and fields of application. They can describe the hardening mechanisms of lightweight materials and can transfer this knowledge to applied problems.
The students can apply basic mechanical models of composites and can depict differences in the mechanical properties depending on composition and structure. The students can describe the basic principle of hybrid material concepts and can judge their advantages in comparison to bulk materials. The students can name special materials for lightweight design and depict differences to conventional materials. The students have the ability to present applications for different lightweight materials and can balance reasons for their use.

Requirements:
Werkstoffkunde I/II (recommended)

Workload:
The workload for the lecture “Materials for Lightweight Construction” is 120 h per semester and consists of the presence during the lectures (24 h), preparation and rework time at home (48 h) and preparation time for the oral exam (48 h).

Examination:
Oral examination, Duration approx. 25 min

Literature
Literaturhinweise, Unterlagen und Teilmanuskript in der Vorlesung
7.145 Course: Materials Recycling and Sustainability [T-MACH-110937]

Responsible: Prof. Dr.-Ing. Peter Elsner
Dr.-Ing. Wilfried Liebig

Organisation: KIT Department of Mechanical Engineering

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

<table>
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<th>Version</th>
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<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>

Competence Certificate
oral exam (about 25 min.)

Prerequisites
none
7 COURSES
Course: Materials Science and Engineering III [T-MACH-105301]

7.146 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

<table>
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<tbody>
<tr>
<td>Oral examination</td>
<td>8</td>
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<td>Each winter term</td>
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Events

<table>
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<th>Title</th>
<th>SWS</th>
<th>Type</th>
<th>Responsible</th>
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<tbody>
<tr>
<td>WT 21/22</td>
<td>Lecture / 📚</td>
<td>Materials Science and Engineering III</td>
<td>4</td>
<td>Blended (On-Site/Online)</td>
<td>Heilmaier, Guth</td>
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<tr>
<td>WT 21/22</td>
<td>Practice / 📚</td>
<td>Exercises in Materials Science and Engineering III</td>
<td>1</td>
<td>Blended (On-Site/Online)</td>
<td>Heilmaier, Kauffmann</td>
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Exams

<table>
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<tr>
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<th>Type</th>
<th>Title</th>
<th>SWS</th>
<th>Type</th>
<th>Responsible</th>
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<td>Materials Science III</td>
<td>1</td>
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<td>Heilmaier, Guth</td>
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</table>

Competence Certificate
Oral exam, about 35 minutes

Prerequisites
T-MACH-110818 - Plasticity of Metals and Intermetallics has not been started

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

Materials Science and Engineering III
2173553, WS 21/22, 4 SWS, Language: German, Open in study portal
Lecture (V) Blended (On-Site/Online)

Content
Properties of pure iron; thermodynamic foundations of single-component and of binary systems; nucleation and growth; diffusion processes in crystalline iron; the phase diagram Fe-Fe3C; effects of alloying on Fe-C-alloys; nonequilibrium microstructures; multicomponent iron-based alloys; heat treatment technology; hardenability and hardenability tests.

Learning objectives:
The students are familiar with the thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid states (nucleation and growth phenomena), the mechanisms of microstructure formation and microstructure-property relationships and can apply them to metallic materials. They can assess the effects of heat treatments and of alloying on the microstructure and the properties of iron-based materials (steels in particular). The can select steels for structural applications in mechanical engineering and subject them to appropriate heat treatments.

Requirements:
Basic knowledge in materials science and engineering (Werkstoffkunde I/II)

Workload:
regular attendance: 53 hours
self-study: 187 hours

Literature
7.147 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

### Events

| ST 2021  | 2174560 | Materials Science and Engineering II for mach, phys | 3 SWS | Lecture / Online | Heilmaier, Pundt |
| ST 2021  | 3174015 | Materials Science and Engineering II (Lecture)      | 3 SWS | Lecture / Online | Gibmeier |
| ST 2021  | 3174026 | Materials Science and Engineering II (Tutorials)    | 1 SWS | Practice / Online| Gibmeier, Mitarbeiter |
| WT 21/22 | 2173550 | Materials Science and Engineering I for mach, phys  | 4 SWS | Lecture / Online | Pundt |
| WT 21/22 | 3173008 | Materials Science and Engineering I (Lecture)       | 4 SWS | Lecture / Online | Gibmeier |
| WT 21/22 | 3173009 | Materials Science and Engineering I (Tutorial)      | 1 SWS | Practice / Online| Gibmeier |

### Exams

| ST 2021  | 76-T-MACH-105145  | Materials Science I, II                         | Heilmaier, Pundt |
| ST 2021  | 76-T-MACH-105145-2 | Materials Science I, II                         | Heilmaier, Pundt |
| ST 2021  | 76-T-MACH-105145-English | Materials Science I & II                      | Heilmaier, Gibmeier |
| ST 2021  | 76-T-MACH-105145-W  | Materials Science I & II                       | Heilmaier, Pundt |

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

### 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:

**Materials Science and Engineering II for mach, phys**

2174560, SS 2021, 3 SWS, Language: German, Open in study portal

Lecture (V)

Blended (On-Site/Online)
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.

Organizational issues
Aktuelle Informationen zu dieser Veranstaltung finden Sie hier: https://www.iam.kit.edu/wk/lehre.php

Literature
Vorlesungsskript; Übungsaufgabenblätter;

Shackelford, J.F.
Werkstofftechnologie für Ingenieure
Verlag Pearson Studium, 2005
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.

Organizational issues
The lecture will be online (asynchronous). The lecture notes, supplementary material and the recording of lecture slides with audio track will be managed via ILIAS. The registration will be possible without restriction until 30.04.2021. Subsequently, registration is only possible by direct contacting Dr.-Ing. Jens Gibmeier.

Literature
Vorlesungsskript; Übungsaufgabenblätter;
Shackelford, J.F.
Werkstofftechnologie für Ingenieure
Verlag Pearson Studium, 2005
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:

Organizational issues
Ort: ID SR 201 Raum 201 Geb. 02.10

Literature
see lecture notes

Materials Science and Engineering I for mach, phys
2173550, WS 21/22, 4 SWS, Language: German, Open in study portal

Blended (On-Site/Online)

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; Übungsaufgabenblätter;
Shackelford, J.F.
Werkstofftechnologie für Ingenieure
Verlag Pearson Studium, 2005
7.148 Course: Materials Science Lab Course [T-MACH-105146]

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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<th>Recurrence</th>
<th>Version</th>
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<td>pass/fail</td>
<td>Each summer term</td>
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Events

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<th>ST 2021</th>
<th>2174597</th>
<th>Experimental Lab Course in Material Science</th>
<th>3 SWS</th>
<th>Practical course / Blended (On-Site/Online)</th>
<th>Heilmaier, Pundt, Dietrich, Guth, Wagner, Kauffmann</th>
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<tr>
<td>ST 2021</td>
<td>3174016</td>
<td>Materials Science and Engineering Lab Course</td>
<td>3 SWS</td>
<td>Practical course / Blended (On-Site/Online)</td>
<td>Gibmeier, Heilmaier, Pundt</td>
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Exams

<table>
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<tr>
<th>ST 2021</th>
<th>76-T-MACH-105146</th>
<th>Materials Science, Lab Course</th>
<th>Heilmaier, Pundt</th>
</tr>
</thead>
</table>

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

Competence 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:

**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-propety-relations.

**requirements:**

Materials Science and Engineering I & II

**workload:**

regular attendance: 22 hours  
self-study: 68 hours
Organizational issues
Blockveranstaltung. Infos durch Aushang am IAM-WK und in der VL WK II. Anmeldung erforderlich.

Literature
Praktikumsskriptum

Shackelford, J.F.
Werkstofftechnologie für Ingenieure
Verlag Pearson Studium, 2005

Materials Science and Engineering Lab Course
3174016, SS 2021, 3 SWS, Language: English, Open in study portal

Practical course (P)
Blended (On-Site/Online)

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-propety-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 IAM-WK bulletin board)

Literature
Praktikumsskriptum

Shackelford, J.F.
Werkstofftechnologie für Ingenieure
Verlag Pearson Studium, 2005
### 7.149 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>
<thead>
<tr>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Expansion</th>
<th>Version</th>
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<td>Written exam</td>
<td>4</td>
<td>Grade to a third</td>
<td>Each winter term</td>
<td>1 terms</td>
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**Events**

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<th>Recurrence</th>
<th>Expansion</th>
<th>Version</th>
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<tr>
<td>WT 21/22</td>
<td>2161254</td>
<td>Mathematical Methods in Continuum Mechanics</td>
<td>2 SWS</td>
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**Exams**

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<th>Recurrence</th>
<th>Expansion</th>
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<td>Mathematical Methods in Continuum Mechanics</td>
<td>2 SWS</td>
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</table>

**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

**Lecture (V)**  
**Blended (On-Site/Online)**  
2161254, WS 21/22, 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
7.150 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

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**Events**

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<td>WT 21/22</td>
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<td>2 SWS</td>
<td>Lecture / 🧩</td>
<td>Böhlke</td>
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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 21/22, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

**Blended (On-Site/Online)**

**Content**

Tensor algebra

- vectors; basis transformation; dyadic product; tensors of 2nd order
- properties of 2nd order tensors: symmetry, anti-symmetry, orthogonality etc.
- eigenvalue problem, theorem of Cayley-Hamilton, invariants; tensors of higher order
- tensor algebra in curvilinear coordinate systems
- tensor analysis in curvilinear coordinate systems
- Differentiation of tensor functions

Application of tensor calculus in strength of materials

- kinematics of infinitesimal and finite deformations
- transport theorem, balance equations, stress tensor
- constitutive equations for solids and fluids
- Formulation of initial-boundary-value problems

**Literature**

Vorlesungsskript

Schade, H.: Strömungslehre, de Gruyter 2013
### 7.151 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

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<td>Übungen zu Mathematische Methoden der Dynamik</td>
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#### Exams

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<th>Course Title</th>
<th>Credits</th>
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**Legend:** Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

written examination, 180 min.

**Prerequisites**

none

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

#### Mathematical Methods in Dynamics

2161206, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**

The students know precisely the mathematical methods of dynamics. They are able to use the basic mathematical methods for modelling the dynamical behaviour of elastic and rigid bodies. The students also have a basic understanding of the description of kinematics and kinetics of bodies. They also master the alternative formulations based on weak formulations and variational methods and the approximate solution methods for numerical calculations of the moving behaviour of elastic bodies.

Dynamics of continua:  
Concept of continuum, geometry of continua, kinematics and kinetics of continua

Variational principles:  
Principle of virtual work, variational calculations, Principle of Hamilton

Approximate solution methods:  
Methods of weighted residuals, method of Ritz
**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


**Mathematical Methods in Dynamics**

2161206, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V) Online**

**Content**

Dynamics of continua:
Concept of continuum, geometry of continua, kinematics and kinetics of continua

Dynamics of rigid bodies:
Kinematics and kinetics of rigid bodies

Variational principles:
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 21/22, 1 SWS, Language: German, [Open in study portal](#)

**Practice (Ü) Blended (On-Site/Online)**

**Content**

Exercises related to the lecture
Course: Mathematical Methods in Fluid Mechanics [T-MACH-105295]

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

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

<table>
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Events

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Exams

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<td>Mathematical Methods in Fluid Mechanics</td>
<td>Lecture</td>
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</table>

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

Mathematical Methods in Fluid Mechanics
2154432, SS 2021, 2 SWS, Language: German/English, [Open in study portal]

Lecture (V) Online

Content
The students can simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical method in fluid mechanics effectively in order to solve the resulting conservation equations analytically, if possible, or to enable simpler numerical access to the problem. They can describe the limits of applicability of the assumptions made to model the flow behavior.

The lecture will cover a selection of the following topics:

- Potential flow theory
- Creeping flows
- Lubrication theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows
- Numerical solution of the governing equation (finite difference methods)

The students can simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical method in fluid mechanics effectively in order to solve the resulting conservation equations analytically, if possible, or to enable simpler numerical access to the problem. They can describe the limits of applicability of the assumptions made to model the flow behavior.
Literature

V Tutorial in Mathematical Methods of Fluid Mechanics
2154433, SS 2021, 1 SWS, Language: German, Open in study portal

Content
The exercises will practise the lecture topics:

- Curvilinear coordinates and tensor calculus
- Potential flow theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows
- Numerical solution of the governing equation (finite difference methods)

Organizational issues
Die Übungen zu Mathematische Methoden der Strömungslehre finden gemeinsam mit der englischen Übung statt.

Literature

V Mathematical Methods in Fluid Mechanics
2154540, SS 2021, SWS, Language: English, Open in study portal

Content
The students can simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical method in fluid mechanics effectively in order to solve the resulting conservation equations analytically, if possible, or to enable simpler numerical access to the problem. They can describe the limits of applicability of the assumptions made to model the flow behavior.

The lecture will cover a selection of the following topics:

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7.153 Course: Mathematical Methods of Vibration Theory [T-MACH-105294]

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

**Part of:**  
- M-MACH-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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**Events**

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**Exams**

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<td>Mathematical Methods of Vibration Theory</td>
<td>Seemann</td>
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</table>

**Compeence Certificate**  
written examination, 180 min.

**Prerequisites**  
none

**Recommendation**  
Engineering Mechanics III/IV

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

**Mathematical methods of vibration theory**

*2162241, SS 2021, 2 SWS, Language: German, Open in study portal*

**Content**

Linear, time-invariant, ordinary single differential equations: homogeneous solution; harmonic, periodic and non-periodic excitations; Duhamel's integral; Fourier and Laplace transform; introduction into the theory of distributions; Systems of ordinary differential equations: matrix notation, eigenvalue theory, fundamental matrix, forced vibrations via modal expansion and transition matrix; Introduction into the dynamic stability theory; Partial differential equations: solution in product form, eigenvalue theory, modal expansion using Ritz series; Variational methods, Hamilton's principle, boundary value problems representing vibrating continua; Perturbation methods

**Literature**

Riemer, Wedig, Wauer: Mathematische Methoden der Technischen Mechanik

**Mathematical methods of vibration theory (Tutorial)**

*2162242, SS 2021, 2 SWS, Language: German, Open in study portal*

**Content**

Seven tutorials with examples of the contents of the course

**Literature**

Riemer, Wedig, Wauer: Mathematische Methoden der Technischen Mechanik
7.154 Course: Mathématiques appliquées aux sciences de l'ingénieur [T-MACH-105452]

Responsible: Prof. Dr. Jean-Yves Dantan
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102746 - Compulsory Elective Module

<table>
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Events

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

Competence Certificate
oral exam, 30 min.

Prerequisites
none

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

Mathématiques appliquées aux sciences de l'ingénieur
2161230, SS 2021, 4 SWS, Language: French, Open in study portal

Content
Courses are taught in French.
First block course at the KIT:
Basics of probability theory and Laplace transformation
Second block course at the Arts et Métiers ParisTech, centre Metz, France
Application of mathematics in the fields of functional safety of structural components, reliability of components and systems, vibrations and control systems.
A visit to an industry partner in the vicinity of Metz will be planned.

Organizational issues
Termine werden auf der Homepage bekannt gegeben
7.155 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

<table>
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Events

ST 2021 2138326 Measurement II 2 SWS Lecture / Online Stiller, Bieder

Exams

ST 2021 76-T-MACH-105335 Measurement II Stiller

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

Competence Certificate
written exam
60 min.
2 DIN A4 Self-created formular sheets allowed

Prerequisites
none

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

Measurement II
2138326, SS 2021, 2 SWS, Language: German, Open in study portal

Content
Lerninhalt (EN)
1. Amplifiers
2. Digital technology
3. Stochastic modeling for measurement applications
4. Estimation
5. Kalman Filter
6. Environmental perception

Lernziele (EN):
The capabilities of modern sensor technology pave the way for novel applications in engineering. Especially digital measurement techniques may be used even in very complex environments and thus have strong impact on technological progress. Stochastic models of measurement processes form the basis for meaningful information processing and provide a valuable tool for engineering. This interdisciplinary lecture addresses students in mechanical engineering and related subjects. The lecture gives an overview of digital technology and stochastics. These areas form the basics of estimation methods that can be embedded elegantly in the theory of state observers. Applications in signal processing for modern environmental perception (video, Lidar, Radar) illustrate the discussed subjects.

Nachweis:
Written exam
60 minutes
Individual sheet of formulas

Arbeitsaufwand:
120 hours
Literature
Skript und Foliensatz zur Veranstaltung werden als kostenlose pdf-Dateien bereitgestellt. Weitere Empfehlungen werden in der Vorlesung bekannt gegeben.

Idealerweise haben Sie zuvor 'Grundlagen der Mess- und Regelungstechnik' gehört oder verfügen aus einer Vorlesung anderer Fakultäten über grundlegende Kenntnisse der Mess- und Regelungstechnik und der Systemtheorie.
### Course: Mechanical Design I & II [T-MACH-105286]

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

**Part of:** M-MACH-102573 - Mechanical Design

**Type**  
Written examination

**Credits**  
5

**Grading scale**  
Grade to a third

**Recurrence**  
Each winter term

**Version**  
2

### Events

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<td>Albers, Burkardt</td>
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### Exams

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<th>Course Title</th>
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<td>Mechanical Design I &amp; II</td>
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<td>Albers, Matthiesen</td>
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<tr>
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<td>76T-MACH-105286_EN</td>
<td>Mechanical Design I &amp; II (english)</td>
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<td></td>
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<td>Albers, Matthiesen</td>
</tr>
</tbody>
</table>

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

### Competence Certificate

Written exam, graded, duration: 60 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 II

**2146178, SS 2021, 2 SWS, Language: German, Open in study portal**

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

### Content

**Lecture content:**

- Bearings
- Sealings
- Design
- Bolted Connections

### Prerequisites

Concomitant to the lecture 2 online tests were carried out and the knowledge from the lecture will be tested. The knowledge from mechanical design I and II will further be controlled with a design and a CAD task.

Further information's will be announced at Ilias and at the beginning of the lecture mechanical design II.
### Literature

**Konstruktionselemente des Maschinenbaus - 1 und 2**  
Grundlagen der Berechnung und Gestaltung von Maschinenelementen;  
or Volltextzugriff über Uni-Katalog der Universitätsbibliothek

**Grundlagen von Maschinenelementen für Antriebsaufgaben;**  
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8

#### Vorlesungsumdruck:

Über die ILIAS-Plattform des RZ werden alle relevanten Inhalte (Folien zu Vorlesung und Saalübung, sowie Übungsblätter) entsprechend den Vorlesungsblöcken gebündelt zur Verfügung gestellt.

<table>
<thead>
<tr>
<th>Mechanical Design II Lecture</th>
<th>3146017, SS 2021, 2 SWS, Language: English, <a href="#">Open in study portal</a></th>
</tr>
</thead>
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<tr>
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</table>

<table>
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<tr>
<th>Mechanical Design I</th>
<th>2145178, WS 21/22, 2 SWS, Language: German, <a href="#">Open in study portal</a></th>
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| Literature                   | [Konstruktionselemente des Maschinenbaus - 1 und 2](#)  
Grundlagen der Berechnung und Gestaltung von Maschinenelementen;  
or Volltextzugriff über Uni-Katalog der Universitätsbibliothek
Grundlagen von Maschinenelementen für Antriebsaufgaben;  
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8 |

<table>
<thead>
<tr>
<th>Mechanical Design I (Lecture)</th>
<th>3145186, WS 21/22, 2 SWS, Language: English, <a href="#">Open in study portal</a></th>
</tr>
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Grundlagen der Berechnung und Gestaltung von Maschinenelementen;  
or Volltextzugriff über Uni-Katalog der Universitätsbibliothek
Grundlagen von Maschinenelementen für Antriebsaufgaben;  
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8 |
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
7 COURSES

7.157 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

<table>
<thead>
<tr>
<th>Type</th>
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<th>Grading scale</th>
<th>Recurrence</th>
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Events

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<td>Tutorials Mechanical Design I</td>
<td>1 SWS</td>
<td>Practice / 🗓️</td>
<td>Albers, Matthiesen, Behrendt, Mitarbeiter</td>
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<tr>
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<td>Practice / 🗓️</td>
<td>Albers, Burkardt</td>
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</table>

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:

**Tutorials Mechanical Design I**

2145185, WS 21/22, 1 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

**Mechanical Design I (Tutorial)**

3145187, WS 21/22, 2 SWS, Language: English, Open in study portal

Practice (Ü)
On-Site

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
7.158 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

<table>
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Exams

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Competence Certificate
Concomitant to the lecture, 2 online tests are carried out and the knowledge from the lecture will be tested. The knowledge from mechanical design I and II will further be controlled with a design and a CAD task.

Prerequisites
None

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

Tutorials Mechanical Design II

2146185, SS 2021, 2 SWS, Language: German, Open in study portal

Practice (Ü)
Blended (On-Site/Online)

Content
Bearings
Sealings
Desing
Bolted connections

tutorials: 10,5 h
prerequisites and preparation to exam: 55 h

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 II Tutorials

3146018, SS 2021, 2 SWS, Language: English, Open in study portal

Practice (Ü)
Blended (On-Site/Online)
Content
Bearings
Sealings
Design
Bolted Connections

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)
# 7.159 Course: Mechanical Design III & IV [T-MACH-104810]

**Responsible:** Prof. Dr.-Ing. Sven Matthiesen  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102573 - Mechanical Design

<table>
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<td>2 SWS</td>
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<td>WT 21/22</td>
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<td>Mechanical Design III</td>
<td>2 SWS</td>
<td>Each term</td>
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<td>Mechanical Design III Lecture</td>
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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 21/22, 2 SWS, Language: German, [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

CAD:
Pro/Engineer Tipps und Techniken, Wolfgang Berg, Hanser Verlag, ISBN: 3-446-22711-3 (für Fortgeschrittene)

V Mechanical Design III (Lecture)
3145016, WS 21/22, 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)
7.160 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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### Events

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<td>76-T-MACH-110955</td>
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</tbody>
</table>

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗫 On-Site, ❌ Canceled

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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**

2145153, WS 21/22, 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**

2145154, WS 21/22, 1 SWS, [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)

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**Mechanical Design III (Tutorial)**
3145017, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)

**Organizational issues**
Termine siehe Lehrveranstaltung 2145154

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**Mechanical Design III (Workshop)**
3145018, WS 21/22, 1 SWS, Language: English, [Open in study portal](#)

---

**CAD:**
Pro/Engineer Tipps und Techniken, Wolfgang Berg, Hanser Verlag, ISBN: 3-446-22711-3 (für Fortgeschrittene)
7 COURSES

Course: Mechanical Design IV, tutorial [T-MACH-110956]

7.161 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

<table>
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<th>Type</th>
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Events

| ST 2021 | 2146184 | Tutorials Mechanical Design IV | 1 SWS | Practice / On-Site | Albers, Matthiesen, Mitarbeiter |
| ST 2021 | 2146187 | Workshop ‘Mechanical Design IV’ | 1 SWS | / On-Site           | Albers, Matthiesen, Mitarbeiter |
| ST 2021 | 3146021 | Mechanical Design IV Tutorials | 1 SWS | Practice / On-Site | Albers, Mitarbeiter            |
| ST 2021 | 3146022 | Mechanical Design IV Workshop  | 1 SWS | / On-Site           | Albers, Mitarbeiter            |

Exams

| ST 2021 | 76-T-MACH-105285 | Mechanical Design IV, tutorial | Albers, Matthiesen |

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 2021, 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)
T 7.162 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

<table>
<thead>
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<th>Events</th>
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<td>Grade to a third</td>
<td>Each winter term</td>
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<td>2173580</td>
<td>Mechanics and Strengths of Polymers</td>
<td>2 SWS</td>
<td>Lecture / Lecture</td>
<td>von Bernstorff</td>
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</table>

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Canceled

**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:**

V Mechanics and Strengths of Polymers
2173580, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Content**
Molecular structure and morphology of polymers, temperature- and time dependency of mechanical behavior, viscoelasticity, time/temperature- superposition principle, yielding, crazing and fracture of polymers, failure criterions, impact and dynamic loading, corresponding principle, tough/brittle-transition, introduction to the principles of fiber reinforcement and multiple cracking in composites

**Learning Objectives:**
The students are prepared to

- repeat the calculus on strength and design of engineering parts exposed to complex loadings,
- estimate the influence of time and temperature on the strength of polymeric materials,
- relate the strength of materials to their molecular structure, morphology and processing parameters and
- derive failure mechanisms for homogenous polymers and composite materials therefrom.

**Requirements:**
Basic knowledge in materials science (e.g. lecture materials science I and II)

**Workload:**
The workload for the lecture Mechanics and Strengths of Polymers is 120 h per semester and consists of the presence during the lecture (28 h) as well as preparation and rework time at home (92 h).

**Literature**
Literaturliste, spezielle Unterlagen und ein Teilmanuskript werden in der Vorlesung ausgegeben.
7.163 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

<table>
<thead>
<tr>
<th>Events</th>
<th>Type</th>
<th>Credits</th>
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<td>Grade to a third</td>
<td>Each winter term</td>
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</table>

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

Competence Certificate
Oral examination, ca. 30 min

Prerequisites
none

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

Mechanics in Microtechnology
2181710, WS 21/22, 2 SWS, Language: German, Open in study portal

Content
1. Introduction: Application and Processing of Microsystems  
2. Scaling Effects  
3. Fundamentals: Stress and Strain, (anisotropic) Hooke’s Law  
4. Fundamentals: Mechanics of Beams and Membranes  
5. Thin Film Mechanics: Origin and Role of Mechanical Stresses  
6. Characterization of Mechanical Properties of Thin Films and Small Structures: Measurement of Stresses and Mechanical Parameters such as Young’s Modulus and Yield Strength; Thin Film Adhesion and Stiction  
7. Transduction: Piezo-resistivity, Piezo-electric Effect, Electrostatics,...  
8. Aktuation: Inverse Piezo-electric Effect, Shape Memory, Electromagnetic Actuation,...

The students know and understand size and scaling effects in micro- and nanosystems. They understand the impact of mechanical phenomena in small dimensions. Based on this they can judge how they determine material processing as well as working principles and design of microsensors and microactuators.

regular attendance: 22.5 hours  
self-study: 97.5 hours  
oral exam ca. 30 minutes

Literature
Folien,  
2. L.B. Freund and S. Suresh: "Thin Film Materials"  
7.164 Course: Metallographic Lab Class [T-MACH-105447]

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

**Organisation:** KIT Department of Mechanical Engineering

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

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<th>Practical course</th>
<th>Heilmaier, Mühl</th>
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</table>

**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:**

**Content**

**Organizational issues**

Anmeldung erforderlich, per Mail an fabian.muehl@kit.edu mit Angaben zu: Name, Immatrikulations-Nr., Studiengang, Semester, Anrechnung als Fachpraktikum, Laborpraktikum oder Schwerpunkt.

!!!! Aufgrund der ungewissen Ausgangslage ist das Format des Praktikums abhängig von der Corona-Verordnung. Voraussichtlich wird das Praktikum in der folgenden Version stattfinden:


Die Koordination der Tage, an denen das Praktikum in dieser Form stattfinden wird, erfolgt in Abstimmung mit den Teilnehmern.


Die Details werden in einer Vorbesprechung erläutert.

Die angemeldeten Teilnehmer werden zu einem ILIAS-Kurs eingeladen und für weitere Details (Zeitplan etc.) kontaktiert.
**Content**

Light microscope in metallography
metallographic sections of metallic materials
Investigation of the microstructure of unalloyed steels and cast iron
Microstructure development of steels with accelerated cooling from the austenite area
Investigation of microstructures of alloyed steels
Investigation of failures quantitative microstructural analysis
Microstructural investigation of technically relevant non-ferrous metals
Application of Scanning electron microscope

**learning objectives:**
The students in this lab class gain are able to perform standard metallographic preparations and are able to apply standard software for quantitative microstructural analyses. Based on this the student can interpret unetched as well as etched microstructures with respect to relevant microstructural features. They can draw concluding correlations between heat treatments, ensuing microstructures and the resulting mechanical as well as physical properties of the investigated materials.

**requirements:**
Material Science I/II

**workload:**
The workload for the Metallographic Lab Class is 120 h per semester and consists of the presence during the lab course (25 h) as well as preparation and rework time at home (95 h).

**Organizational issues**
Der Anmeldezeitraum für das WS 21/22 ist Anfang September!

**Literature**
Macherauch, E.: Praktikum in Werkstoffkunde, 10. Aufl., 1992

Literaturliste wird zu jedem Versuch ausgegeben
7.165 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

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<th>Microenergy Technologies</th>
<th>2 SWS</th>
<th>Lecture / Online</th>
<th>Kohl</th>
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**Exams**

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<th>Microenergy Technologies</th>
<th>Kohl</th>
</tr>
</thead>
</table>

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 2021, 2 SWS, Language: English, Open in study portal

**Lecture (V)**

Online

**Content**

- Basic physical principles of energy conversion  
- Layout and design optimization  
- Technologies  
- Selected devices  
- Applications

The lecture includes amongst others the following topics:

- Micro energy harvesting of vibrations  
- Thermal micro energy harvesting  
- Microtechnical applications of energy harvesting  
- Heat pumps in micro technology  
- Micro cooling

**Literature**

- Folienskript "Micro Energy Technologies"  
7.166 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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<th>Lecturer</th>
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<td>ST 2021</td>
<td>2183703</td>
<td>Modelling and Simulation</td>
<td>2+1</td>
<td>Lecture / Practice</td>
<td>Nestler</td>
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<td>WT 21/22</td>
<td>2183703</td>
<td>Numerical methods and simulation techniques</td>
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<td>Lecture / Practice</td>
<td>Nestler</td>
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**Exams**

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<td>Modelling and Simulation</td>
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<td>Lecture / Practice</td>
<td>Nestler</td>
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</table>

**Legend:** 🌐 Online, 🧩 Blended (On-Site/Online), ⚒ On-Site, ❌ Cancelled

**Competence Certificate**

Written exam, 90 min

**Prerequisites**

none

**Recommendation**

Preliminary knowledge in mathematics, physics and materials science

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

V Modelling and Simulation  
2183703, SS 2021, 2+1 SWS, Language: German, Open in study portal  
Lecture / Practice (VÜ) Online
Content
The course gives an introduction to modelling and simulation techniques. The following topics are included:
- splines, interpolation methods, Taylor series
- finite difference method
- dynamical systems
- numerics of partial differential equations
- mass and heat diffusion
- microstructure simulation
- parallel and adaptive algorithms
- high performance computing
- practical exercises
The student can
- explain the basic algorithms and numerical methods which are beside other applications relevant for materials simulations.
- describe and apply numerical solution methods for partial differential equations and dynamical systems
- apply numerical methods to solve heat and mass diffusion problems which can also be used to model microstructure formation processes.
- has experiences in how to implement and program the introduced numerical methods from an integrated computer lab.

preliminary knowlegde in mathematics, physics and materials science recommended
regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours
We regularly hand out exercise sheets. In addition, the course will be accompanied by practical exercises at the computer.
written examination: 90 minutes

Organizational issues
Die Termine für die Übungen werden in der Vorlesung und im Ilias bekannt gegeben.

Literature

Numerical methods and simulation techniques
2183703, WS 21/22, 3 SWS, Language: German, Open in study portal

Content
The course gives an introduction to modelling and simulation techniques. The following topics are included:
- splines, interpolation methods, Taylor series
- finite difference method
- dynamical systems
- numerics of partial differential equations
- mass and heat diffusion
- microstructure simulation
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The student can
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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
Termine für Rechnerübungen werden in der Vorlesung bekannt gegeben!
Literature

7.167 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

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<td>2183702</td>
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<td>August, Nestler</td>
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<th>Exams</th>
<th>Code</th>
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<th>Grading scale</th>
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<td>August, Nestler, Weygand</td>
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</table>

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

**Competence Certificate**
oral exam 30 min

**Prerequisites**
none

**Recommendation**
materials science  
fundamental mathematics

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

**Modelling of Microstructures**

2183702, WS 21/22, 3 SWS, Language: German, [Open in study portal](#)  

Lecture / Practice (VÜ)  
Online
Content

• Brief Introduction in thermodynamics
• Statistical interpretation of entropy
• Gibbs free energy and phase diagrams
• Free energy functional
• Phasefield equation
• Gibbs-Thomson-equation
• Driving forces
• Grand chemical potential functional and the evolution equations
• For compare: Free energy functional with driving forces

The student can

• explain the thermodynamic and statistical foundations for liquid-solid and solid-solid phase transition processes and apply them to construct phase diagrams.
• describe the specific characteristics of dendritic, eutectic and peritectic microstructures.
• explain the mechanisms of grain and phase boundary motion induced by external fields
• use the phase-field method for simulation of microstructure formation processes using modeling approaches and challenges of current research
• has experiences in computing and conduction simulations of microstructure formation from an integrated computer lab.

knowledge in materials science and in fundamental mathematics recommended
regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours
We regularly hand out exercise sheets. The individual solutions will be corrected.
oral exam ca. 30 min

Literature

4. Gaskell, D.R., Introduction to the thermodynamics of materials
5. Übungsblätter
7 COURSES

Course: Modern Control Concepts I [T-MACH-105539]

Responsibility: apl. Prof. Dr. Lutz Groell
              apl. Prof. Dr. Jörg Matthes

Organisation: KIT Department of Mechanical Engineering

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

Type
Written examination

Credits
4

Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events

ST 2021 2105024 Modern Control Concepts I 2 SWS Lecture / 🔄 Matthes, Groell
ST 2021 2106020 Tutorial on Modern Control Concepts I 2 SWS Practice / 🔄 Matthes

Exams

ST 2021 76-T-MACH-105539 Modern Control Concepts I Matthes
WT 21/22 76-T-MACH-105539 Modern Control Concepts I Matthes

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

Competence Certificate
Written exam (Duration: 1 h)

Prerequisites
none

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

Modern Control Concepts I
2105024, SS 2021, 2 SWS, Language: German, Open in study portal

Lecture (V)
Online

Literature


Tutorial on Modern Control Concepts I
2106020, SS 2021, 2 SWS, Language: German, Open in study portal

Practice (Ü)
Online

Content

Learning Content:

1. Introduction (system classes, nomenclature)
2. Equilibria
3. Linearization (software based, Hartman-Grobman-Theorem)
4. Parameter identification of linear dynamic models (SISO+MIMO)
5. PID-controller (realization, design-hints, Anti-Windup-mechanisms)
6. 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

**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

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<td>WT 21/22</td>
<td>2141865</td>
<td>Novel actuators and sensors</td>
<td>2 SWS</td>
<td>Lecture / 🧩</td>
<td>Kohl, Sommer</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 21/22, 2 SWS, Language: German, [Open in study portal]

**Literature**

- Vorlesungsskript "Neue Aktoren" und Folienskript "Sensoren"
- Donald J. Leo, Engineering Analysis of Smart Material Systems, John Wiley & Sons, Inc., 2007
7.170 Course: Numerical Fluid Mechanics [T-MACH-105338]

**Responsible:** 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

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

**Competence Certificate**  
oral exam - 30 minutes

**Prerequisites**  
none

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

**Numerical Fluid Mechanics**  
2153441, WS 21/22, 2 SWS, Language: German, Open in study portal

**Content**  
The course covers the following topics:

1. basic equations of computational fluid dynamics  
2. main discretization methods for fluid mechanics problems, with focus on finite differences and finite volumes  
3. boundary and initial conditions  
4. mesh generation and mesh treatment  
5. solution algorithms for linear and nonlinear systems of equations  
6. solution strategies for the incompressible Navier-Stokes equations  
7. introduction to the solution of the compressible Navier-Stokes equations  
8. examples of numerical simulation in practice

**Literature**  
7.171 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

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<th>Photovoltaics</th>
<th>4 SWS</th>
<th>Lecture / Online</th>
<th>Powalla, Lemmer</th>
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<tr>
<td>ST 2021</td>
<td>2313738</td>
<td>Tutorial 2313737 Photovoltaik</td>
<td>1 SWS</td>
<td>Practice / Online</td>
<td>Powalla, Lemmer</td>
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**Exams**

| ST 2021       | 7313737 | Photovoltaics | Powalla, Lemmer |

**Legend:** 📚 Online, 🎫 Blended (On-Site/Online), ⬆ On-Site, ❌ Cancelled

**Prerequisites**

"M-ETIT-100524 - Solar Energy" must not have started.

Responsible: apl. Prof. Dr. Ron Dagan  
Organisation: KIT Department of Mechanical Engineering  
Part of: M-MACH-102816 - Major Field: Fundamentals of Energy Technology

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Events

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<tr>
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<th>Credits</th>
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<tr>
<td>WT 21/22</td>
<td>2189906</td>
<td>Physical and chemical principles of nuclear energy in view of reactor accidents and back-end of nuclear fuel cycle</td>
<td>1 SWS</td>
<td>Lecture / 🗣</td>
<td>Dagan, Metz</td>
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Exams

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<td>WT 21/22</td>
<td>76-T-MACH-105537</td>
<td>Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle</td>
<td>Dagan</td>
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Legend: 🖥 Online, 📦 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate
oral exam, approx. 30 min.

Prerequisites
none

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

Lecture V: Physical and chemical principles of nuclear energy in view of reactor accidents and back-end of nuclear fuel cycle  
2189906, WS 21/22, 1 SWS, Language: German, Open in study portal

Lecture (V) On-Site
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)
7.173 Course: Physical Basics of Laser Technology [T-MACH-102102]

Responsibility: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102746 - Compulsory Elective Module

Type: Oral examination
Credits: 5
Grading scale: Grade to a third
Recurrence: Each winter term
Version: 3

Events

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<th>Code</th>
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<td>2181612</td>
<td>Physical basics of laser technology</td>
<td>3 SWS</td>
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<td>Each winter term</td>
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Exams

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<td>Physical Basics of Laser Technology</td>
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</table>

Legend: 📚 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate
oral examination (30 min)

no tools or reference materials

Prerequisites
It is not possible, to combine this brick with brick Laser Application in Automotive Engineering [T-MACH-105164] and brick Physical Basics of Laser Technology [T-MACH-109084]

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105164 - Laser in Automotive Engineering must not have been started.

Recommendation
Basic knowledge of physics, chemistry and material science

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

Physical basics of laser technology
2181612, WS 21/22, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ) Online

In: Bachelor Program Mechanical Engineering , Date: 15/09/2021
Module Handbook valid from Winter Term 21/22
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
7.174 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>Grade to a third</td>
<td>Each summer term</td>
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</table>

**Events**

| ST 2021 | 2142890 | Physics for Engineers | 4 SWS | Lecture / Practice ( / 🖥) | Weygand, Dienwiebel, Nesterov-Müller, Gumbsch |

**Exams**

| ST 2021 | 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:

<table>
<thead>
<tr>
<th>Physics for Engineers</th>
<th>Lecture / Practice (VÜ)</th>
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<tbody>
<tr>
<td>2142890, SS 2021, 4 SWS, Language: German, Open in study portal</td>
<td>Online</td>
</tr>
</tbody>
</table>
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
Kursbeitritt erfolgt bis zum 15.4.2021 (erste Vorlesung) ohne Passwort.
Kontakt: daniel.weygand@kit.edu

Literature
   - Tipler und Mosca: Physik für Wissenschaftler und Ingenieure, Elsevier, 2004
   - Harris, Moderne Physik, Pearson Verlag, 2013
**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

<table>
<thead>
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**Events**

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<td>PLM-CAD Workshop</td>
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<td>2121357</td>
<td>PLM-CAD Workshop</td>
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<td>Project (P / 🧩)</td>
<td>Ovtcharova, Mitarbeiter</td>
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</table>

**Exams**

| ST 2021 | 76-T-MACH-102153 | PLM-CAD Workshop | Ovtcharova |

**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, SS 2021, 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

**PLM-CAD Workshop**
2121357, WS 21/22, 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.

**Literature**
Workshop-Unterlagen / workshop materials
7.176 Course: Polymer Engineering I [T-MACH-102137]

Responsible: Prof. Dr.-Ing. Peter Elsner
Dr.-Ing. Wilfried Liebig
Organisation: KIT Department of Mechanical Engineering

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

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Events

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Exams

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</table>

Competence Certificate

Oral exam, about 25 minutes

Prerequisites

none

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

Content

1. Economical aspects of polymers
2. Introduction of mechanical, chemical, and electrical properties
3. Processing of polymers (introduction)
4. Material science of polymers
5. Synthesis

Learning objectives:
The field of Polymer Engineering includes synthesis, material science, processing, construction, design, tool engineering, production technology, surface engineering, and recycling. The aim is, to equip the students with knowledge and technical skills, and to use the material "polymer" meeting its requirements in an economical and ecological way.

The students

- are able to describe and classify polymers based on the fundamental synthesis processing techniques
- can find practical applications for state-of-the-art polymers and manufacturing technologies
- are able to apply the processing techniques, the application of polymers and polymer composites regarding to the basic principles of material science
- can describe the special mechanical, chemical and electrical properties of polymers and correlate these properties to the chemical bindings.
- can define application areas and the limitation in the use of polymers

Requirements:

none

Workload:

Regular attendance: 21 hours
Self-study: 99 hours
**Organizational issues**

**Literature**
Literaturhinweise, Unterlagen und Teilmanuskript werden in der Vorlesung ausgegeben.
7.177 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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**Events**

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<td>Powertrain Systems Technology A: Automotive Systems</td>
<td>Albers, Ott</td>
<td></td>
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</tbody>
</table>

**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 2021, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V) Online**

**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
### 7.178 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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<td>Powertrain Systems Technology B: Stationary Machinery</td>
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**Exams**

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<td>Albers, Ott</td>
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**Legend:**  
🖥 Online, 🌈 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

text exam: 60 min duration

**Prerequisites**

None

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

**Powertrain Systems Technology B: Stationary Machinery**

2145150, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Content**

Students acquire the basic skills needed to develop future energy-efficient and safe drive system solutions for use in industrial environments. The course considers holistic development methods and evaluations of drive systems. The focal points can be divided into the following chapters:

- Powertrain System
- Operator System
- Environment System
- System Components
- Development Process

**Recommendations:**

- Powertrain Systems Technology A: Automotive Systems

**Literature**

VDI-2241: "Schaltäre fremdbetätigte Reibkupplungen und -bremsen", VDI Verlag GmbH, Düsseldorf  
7.179 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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**Events**

| ST 2021 | 2162208 | Schwingungstechnisches Praktikum | Practical course / Fidlin, Bitner |

**Exams**

| ST 2021 | 76-T-MACH-105373 | Practical Training in Measurement of Vibrations | Fidlin |

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: Presentation [T-MACH-109189]

**Responsible:** Prof. Dr.-Ing. Martin Heilmairier  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104494 - Bachelor Thesis

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<th>Each term</th>
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</table>

#### 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 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:** Dr. Günter Schell  
**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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<td></td>
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<td>Basic principles of powder metallurgical and ceramic processing</td>
<td>2 SWS</td>
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<td>WT 21/22</td>
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#### Exams

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**Competence Certificate**  
The assessment consists of an oral exam (20-30 min) taking place at the agreed date. The re-examination is offered upon agreement.

**Prerequisites**  
none

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

#### Basic principles of powder metallurgical and ceramic processing

2193010, WS 21/22, 2 SWS, Language: German, Open in study portal  
Lecture (V) Blended (On-Site/Online)

**Literature**

- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005
7.182 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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Events

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<td>2149670</td>
<td>Lecture / 🧩</td>
<td>2 SWS</td>
<td>Steegmüller, Kienzle</td>
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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 21/22, 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.

The lecture is a block course. An application in Ilias is mandatory.

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

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
Course: Product Lifecycle Management [T-MACH-105147]

7.183 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

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Events

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Exams

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<td>76-T-MACH-105147</td>
<td>Product Lifecycle Management</td>
<td>Ovtcharova</td>
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</table>

Prerequisites
None

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

Product Lifecycle Management
2121350, WS 21/22, 2 SWS, Language: German, Open in study portal
Lecture (V) Blended (On-Site/Online)

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

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

Type: Oral examination
Credits: 4
Grading scale: Grade to a third
Recurrence: Each summer term
Version: 2

Events

| ST 2021 | 2123364 | Product, Process and Resource Integration in the Automotive Industry | 2 SWS | Lecture / 🖥 | Mbang |

Exams

| ST 2021 | 76-T-MACH-102155 | Product, Process and Resource Integration in the Automotive Industry | Mbang |

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

Competence Certificate
Oral examination 20 min.

Prerequisites
None

Annotation
Limited number of participants.

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

Product, Process and Resource Integration in the Automotive Industry
2123364, SS 2021, 2 SWS, Language: German, Open in study portal

Content

- Overview of product development in the automotive sector (process- and work cycle, IT-Systems)
- Integrated product models in the automotive industry (product, process and resource)
- New CAX modeling methods (intelligent feature technology, templates & functional modeling)
- Automation and knowledge-based mechanism for product design and production planning
- Product development in accordance with defined process and requirement (3D-master principle, tolerance models)
- Concurrent Engineering, shared working
- Enhanced concepts: the digital and virtual factory (application of virtual technologies and methods in the product development)

Organizational issues
Blockveranstaltung

Literature
Vorlesungsfolien
7.185 Course: Production Operations Management [T-MACH-100304]

**Responsible:** Prof. Dr.-Ing. Kai Furmans  
Prof. Dr.-Ing. Gisela Lanza  
Prof. Dr. Frank Schultmann  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-100297 - Production Operations Management

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<td>Production Operations Management</td>
<td>3 SWS</td>
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**Exams**

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

**Competence Certificate**

written exam (duration: 180 min)

**Prerequisites**

T-MACH-108734 - Production Operations Management-Project must have been completed successfully.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-108734 - Production Operations Management-Project must have been passed.

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

**Production Operations Management**

2110085, WS 21/22, 3 SWS, Language: German, [Open in study portal](https://ilias.studium.kit.edu/)

**Lecture / Practice (VÜ)**

Blended (On-Site/Online)

**Content**

It is a joint lecture of the Institute of Materials Handling and Logistics (IFL) and the Institute of Production Science (WBK). The institutes alternate with each cycle.  
The lecture covers the basics of operations and supply chain management as well as business management basics in accounting, investment calculation and legal forms.

If you successfully passed this course you will be able to:

- state the relevant technical terms of business administration, logistics and production engineering  
- describe the interrelation between these technical terms  
- describe the most important decision problems qualitatively and quantitatively  
- apply the appropriate decision models to solve the respective decision problems  
- critically evaluate the results and draw appropriate conclusions  
- extend the learned methods and models by researching on your own

The brick "Production Operations Management-Project" must be successfully completed before the course "Production Operations Management" can be completed.

**Media:**

Lecture notes will be provided in ilias (https://ilias.studium.kit.edu/).  
regular attendance: 25 hours  
self-study: 65 hours
Literature
7.186 Course: Production Operations Management-Project [T-MACH-108734]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-100297 - Production Operations Management

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**Events**

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<td>Each winter term</td>
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**Competence Certificate**

Assignments during the semester consisting of solving and presenting case studies, whereof:

- 70% assessment of the case study as group work
- 30% evaluation of the defense of the case studies as an individual grade

**Prerequisites**

none

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

**Production Operations Management-Project**

2110086, WS 21/22, 1 SWS, Language: German, Open in study portal

**Content**

Students are divided into groups for this course. Case studies will be carried out in these groups. The result of the group work is presented and evaluated in writing. In addition, the groups will present and defend their results in colloquia.

After successful completion of the lecture you will be able to work alone and in a team

- to **name** the treated **technical terms** in the areas of production, logistics and business administration,
- to **accurately describe** the connections between these areas in a discussion with experts,
- to **describe qualitatively** and **quantitatively** the most important decision-making problems in this field,
- to use the corresponding qualitative and quantitative decision models,
- to **critically evaluate** their results and draw conclusions from them,
- as well as to expand the methods and models discussed through **own research**.

The participation of all members of the selected groups in the oral defenses is compulsory and will be controlled. For the written submission the group receives a common grade, in the defense each group member is evaluated individually. The defenses are fully included in the grade, but they do not have to be passed in order to pass the entire event. The final score of the event consists of 70% of the written submissions and 30% of the defense evaluation.

It is a joint lecture of the Institute of Materials Handling and Logistics (IFL) and the Institute of Production Science (WBK). The institutes alternate with each cycle.

Please inform yourself about the course of this event in good time, at the latest at the introductory event! It is necessary to register at the beginning of the semester, a later entry into the course is not possible.

**Attendance time:** 17 hours,  
Self-study: 43 hours

**Literature**

7.187 Course: Production Technology for E-Mobility [T-MACH-110984]

**Responsible:** Prof. Dr.-Ing. Jürgen Fleischer  
Dr.-Ing. Janna Ruhland  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-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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**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:**

**Production Technology for E-Mobility**

2150605, SS 2021, 2 SWS, Language: German, [Open in study portal](https://ilias.studium.kit.edu/)

**Content**

In the lecture Production Engineering for Electromobility the students should be enabled to design, select and develop production processes for the production of the components of an electric drive train (electric motor, battery cells, fuel cells) by using research-oriented teaching.

**Learning Outcomes:**

The students are able to:

- describe the structure and function of a fuel cell, an electric traction drive and a batteriesystem.
- reproduce the process chains for the production of the components fuel cell, battery and electric traction drive.
- apply methodical tools to solve problems along the process chain.
- derive the challenges in the production of electric drives for electric mobility.
- describe the factors influencing the individual process steps on each other using the process chain of Li-ion battery cells.
- enumerate or describe the necessary process parameters to counteract the influencing factors of the process steps in Li-ion battery cell production.
- apply methodical tools to solve problems along the process chain for the production of Li-ion battery cells.
- derive the challenge of mounting and dismounting battery modules.
- derive the challenges in the production of fuel cells for use in mobility.

**Workload:**

regular attendance: 42 hours  
self-study: 78 hours

**Organizational issues**

Die Lehrveranstaltung wird erstmalig im Sommersemester 2021 angeboten.

**Literature**

Skript zur Veranstaltung wird über Ilias ([https://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/))
### 7.188 Course: Programming in CAE-Applications [T-MACH-111431]

**Responsible:** Dr.-Ing. Luise Kärger  
**Organisation:** KIT Department of Mechanical Engineering

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

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<td>Programming in CAE-Applications</td>
<td>2 SWS</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗿 On-Site, ❌ Cancelled

**Competence Certificate**  
Colloquia on exercises during the semester and presentation of a group task at the end of the semester (ungraded)

**Prerequisites**  
The number of participating students is limited. Details for the admission process can be found in the category "Organizational issues" of the associated event.

**Recommendation**

- Basics of the finite element method (ideally with Abaqus)
- Basic knowledge of continuum mechanics
- Basics of programming
- Basic knowledge of fibre-reinforced polymers

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

**Programming in CAE-Applications**  
2113109, WS 21/22, 2 SWS, Language: German, Open in study portal  
Practical course (P) 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


The room allocation and the weekly course date will be announced at the beginning of the winter semester on the Institute's homepage (https://www.fast.kit.edu/lbt/1205.php).

Due to the desired supervision ratio and the institute's equipment, the maximum number of participating students is limited. Preliminary registration takes place via the associated form on the Institute's homepage (https://www.fast.kit.edu/lbt/1205.php), which will be published there together with further details at the beginning of September. If there are too many interested students, a selection will take place among all interested students.
7.189 Course: Project Internship Additive Manufacturing: Development and Production of an Additive Component [T-MACH-110960]

**Responsible:** Dr.-Ing. Frederik Zanger  
**Organisation:** KIT Department of Mechanical Engineering  

**Part of:**  
M-MACH-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**

| WT 21/22 | 2149700 | Project Internship Additive Manufacturing: Development and Production of an Additive Component | 2 SWS | Practical course / 📇 | Zanger, Lubkowitz |

**Competence Certificate**  
Alternative test achievement (graded):

- Milestone based presentation of the results in presentation form (10 min) and submitting of the presentation file with weighting 30%
- Oral exam (15 min) with weighting 40%
- Project work with weighting 30%

**Prerequisites**  
none

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

**Project Internship Additive Manufacturing: Development and Production of an Additive Component**  
2149700, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)  
Practical course (P)  
Blended (On-Site/Online)
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 rew or

The topics addressed in the course will be applied practically in various workshops on the individual topics and transferred to the developmental task in self-study. Finally, the results of the elaborations are produced additively and post-processed subtractively.

Learning Outcomes:
The students ...

- are able to describe the properties and applications of the additive manufacturing processes laser powder bed fusion (LPBF) and lithography assisted ceramic manufacturing (LCM).
- are able to select the appropriate manufacturing process for a technical application.
- are able to describe and implement the creation of a product along the entire additive process chain (CAD, simulation, work preparation, CAM) from the idea to the production.
- are able to discuss the development process for components that are optimized for additive manufacturing.
- are able to perform topology optimization.
- are able to simulate the additive process, compensate for process-related distortions and determine the ideal alignment on the building platform.
- are able to create necessary support structures for the additive process and to derive a building order file.
- are able to create a CAM model for the subtractive rework process of additive parts.

Workload:
regular attendance: 12 hours
self-study: 108 hours

Organizational issues
Termine werden über Ilias bekannt gegeben.
Bei der Vorlesung handelt es sich um eine Blockveranstaltung.
Eine Anmeldung über Ilias ist erforderlich.
Dates will be announced via Ilias.
The lecture is a block event.
A registration via Ilias is required.

Literature
Skript zur Veranstaltung wird über Ilias (https://ilias.studium.kit.edu/) bereitgestellt
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)
7.190 Course: Project Management in Global Product Engineering Structures [T-MACH-105347]

Responsible: Prof. Dr.-Ing. Albert Albers
                 Prof. Dr.-Ing. Peter Gutzmer
                 Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-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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Competence Certificate
oral exam (20 min)
Aids: None

Prerequisites
none
7.191 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>
<thead>
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<td>Each term</td>
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**Events**

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<th>Course Description</th>
<th>SWS</th>
<th>Type</th>
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<tr>
<td>2115817</td>
<td>ST 2021</td>
<td>Project Workshop: Automotive Engineering</td>
<td>3</td>
<td>Lecture / Online</td>
<td>Gauterin, Gießler, Frey</td>
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<tr>
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<td>WT 21/22</td>
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<td>3</td>
<td>Lecture / On-Site</td>
<td>Gauterin, Gießler, Frey</td>
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**Exams**

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<th>Course Description</th>
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<tr>
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<td>Project Workshop: Automotive Engineering</td>
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<td>Gauterin</td>
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**Legend:** Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**
Oral examination  
Duration: 30 up to 40 minutes  
Auxiliary means: none

**Prerequisites**
none

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

**Project Workshop: Automotive Engineering**

2115817, SS 2021, 3 SWS, Language: German, Open in study portal

**Content**

During the Project Workshop Automotive Engineering a team of six persons will work on a task given by an German industrial partner using the instruments of project management. The task is relevant for the actual business and the results are intended to be industrialized after the completion of the project workshop.

The team will generate approaches in its own responsibility and will develop solutions for practical application. Coaching will be supplied by both, company and institute.

At the beginning in a start-up meeting goals and structure of the project will be specified. During the project workshop there will be weekly team meetings. Also a milestone meeting will be held together with persons from the industrial company. In a final presentation the project results will be presented to the company management and to institute representatives.

Learning Objectives:
The students are familiar with typical industrial development processes and working style. They are able to apply knowledge gained at the university to a practical task. They are able to analyze and to judge complex relations. They are ready to work self-dependently, to apply different development methods and to work on approaches to solve a problem, to develop practice-oriented products or processes.

**Organizational issues**
Begrenzte Teilnehmerzahl mit Auswahlverfahren, die Bewerbungen sind am Ende des vorhergehenden Semesters einzureichen.

Raum und Termine: s. Aushang
Skripte werden beim Start-up Meeting ausgegeben.

Project Workshop: Automotive Engineering
2115817, WS 21/22, 3 SWS, Language: German, Open in study portal

Content
During the Project Workshop Automotive Engineering a team of six persons will work on a task given by an German industrial partner using the instruments of project management. The task is relevant for the actual business and the results are intended to be industrialized after the completion of the project workshop.

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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.
Responsible: Stephan Rhode
Organisation: M-MACH-102818 - Major Field: Vehicle Technology

<table>
<thead>
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Events

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<th>Type</th>
<th>Credits</th>
<th>Grade</th>
<th>Recurrence</th>
<th>Lecture</th>
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<tr>
<td>ST 2021</td>
<td>2114862</td>
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<td>Python Algorithms for Automotive Engineering</td>
<td>2 SWS</td>
<td>Lecture</td>
<td>4</td>
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Exams

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<th>Code Type</th>
<th>Name</th>
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<th>Type</th>
<th>Credits</th>
<th>Grade</th>
<th>Recurrence</th>
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<td>76-T-MACH-110796</td>
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<td>Python Algorithm for Vehicle Technology</td>
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Legend: 📲 Online, ⚽ Blended (On-Site/Online), ⚽ On-Site, ☑ Cancelled

Competence Certificate

Written Examination

Duration: 90 minutes

Prerequisites

none

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

Python Algorithms for Automotive Engineering

2114862, SS 2021, 2 SWS, Language: German, Open in study portal

Lecture (V) | Online

Content

Teaching content:

- Introduction to Python and useful tools and libraries for creating algorithms, graphical representation, optimization, symbolic arithmetic and machine learning
  - Anaconda, Pycharm, Jupyter
  - NumPy, Matplotlib, SymPy, Scikit-Learn
- Methods and tools for creating software
  - Version management GitHub, git
  - Testing software pytest, Pylint
  - Documentation SphinX
  - Continuous Integration (CI) Travis CI
  - Workflows in Open Source and Inner Source, Kanban, Scrum
- Practical programming projects to:
  - Road sign recognition
  - Vehicle state estimation
  - Calibration of vehicle models by mathematical optimization
  - Data-based modelling of the powertrain of an electric vehicle

Objectives:

The students have an overview of the programming language Python and important Python libraries to solve automotive engineering problems with computer programs. The students know current tools around Python to create algorithms, to apply them and to interpret and visualize their results. Furthermore, the students know basics in the creation of software to be used in later programming projects in order to develop high-quality software solutions in teamwork. Through practical programming projects (road sign recognition, vehicle state estimation, calibration, data-based modelling), the students can perform future complex tasks from the area of driver assistance systems.
Organizational issues
Campus Ost, Geb. 70.04, Raum 219
Termine siehe Institutshomepage
Bitte bringen Sie Ihren Laptop mit zu den Vorlesungen!
Please bring your laptop to the lecture!

Literature
- A Whirlwind Tour of Python, Jake VanderPlas, Publisher: O'Reilly Media, Inc. Release Date: August 2016, ISBN: 9781492037859 [link](https://link)
- Introduction to Machine Learning with Python, Sarah Guido, Andreas C. Müller, Publisher: O'Reilly Media, Inc., Release Date: October 2016, ISBN: 9781449369880, [link](https://link)
### 7.193 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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#### Events

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<td>Quality Management</td>
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</table>

#### Exams

| ST 2021 | 76-T-MACH-102107 | Quality Management | Lanza |

**Competence Certificate**  
Written Exam (60 min)

**Prerequisites**  
none

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

- **Quality Management**  
  2149667, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)  
- **Lecture (V)**  
  Blended (On-Site/Online)
Content
Based on the quality philosophies Total Quality Management (TQM) and Six Sigma, the lecture deals with the requirements of modern quality management. Within this context, the process concept of a modern enterprise and the process-specific fields of application of quality assurance methods are presented. The lecture covers the current state of the art in preventive and non-preventive quality management methods in addition to manufacturing metrology, statistical methods and service related quality management. The content is completed with the presentation of certification possibilities and legal quality aspects.

Main topics of the lecture:

- The term "Quality"
- Total Quality Management (TQM) and Six Sigma
- Universal methods and tools
- QM during early product stages – product denition
- QM during product development and in procurement
- QM in production – manufacturing metrology
- QM in production – statistical methods
- QM in service
- Quality management systems
- Legal aspects of QM

Learning Outcomes:
The students …

- are capable to comment on the content covered by the lecture.
- are capable of substantially quality philosophies.
- are able to apply the QM tools and methods they have learned about in the lecture to new problems from the context of the lecture.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques they have learned about in the lecture for a specific problem.

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

Organizational issues
Start: 18.10.2021
Vorlesungstermine montags 10:00 Uhr
Übung erfolgt während der Vorlesung

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

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
Course: Rail System Technology [T-MACH-106424]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102638 - Major Field: Rail System Technology

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

### Events

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<th>2 SWS</th>
<th>Lecture / 🖥</th>
<th>Heckele, Gratzfeld</th>
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<td>76-T-MACH-106425</td>
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### Exams

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<th>2 SWS</th>
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<td>Rail System Technology</td>
<td>2 SWS</td>
<td>Heckele, Reimann, Gratzfeld</td>
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</tbody>
</table>

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

### Competence Certificate

**Oral examination**

Duration: ca. 20 minutes

No tools or reference materials may be used during the exam.

### Prerequisites

none

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

**Rail System Technology**  
2115919, SS 2021, 2 SWS, Language: German, Open in study portal

**Lecture (V) Online**

**Content**

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

**Organizational issues**

Die Vorlesung "Bahnsystemtechnik" findet im SS 2021 als asynchrone Online-Veranstaltung statt.

**Literature**

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.  
A bibliography is available for download (Ilias-platform).

**Rail System Technology**  
2115919, WS 21/22, 2 SWS, Language: German, Open in study portal

**Lecture (V) On-Site**
Content
1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

Literature
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung. A bibliography is available for download (Ilias-platform).
7.195 Course: Rail Vehicle Technology [T-MACH-105353]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102638 - Major Field: Rail System Technology

**Events**

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<th>Recurrence</th>
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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**

Oral examination

Duration: ca. 20 minutes

No tools or reference materials may be used during the exam.

**Prerequisites**

none

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

**Rail Vehicle Technology**

2115996, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, 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

**Organizational issues**

Die Vorlesung “Schienenfahrzeugtechnik” findet im SS 2021 als asynchrone Online-Veranstaltung statt.

**Literature**

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

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

**Rail Vehicle Technology**

2115996, WS 21/22, 2 SWS, Language: German, Open in study portal
Content

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, coupling, doors and windows
3. Bogies: forces, running gears, bogies, Jakobs-bogies, active components, connection to car body, wheel arrangement
4. Drives: principles, electric drives (main components, asynchronous traction motor, inverter, with DC supply, with AC supply, without line supply, multisytem 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).
7.196 Course: Railways in the Transportation Market [T-MACH-105540]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102638 - Major Field: Rail System Technology

**Events**

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**Exams**

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<td>Each summer term</td>
<td>1</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 2021, 2 SWS, Language: German, [Open in study portal](#)

**Content**

The lecture gives an overview about perspective, challenges and chances of rail systems in the national and European market. Following items will be discussed:

- Introduction and basics
- Rail reform in Germany
- Overview of Deutsche Bahn
- Regulation of railways
- Financing and development of rail infrastructure
- Group strategy “Strong Rail” and their building blocks: (climate, environment, digitalization, “Strong Rail” in Baden-Württemberg)
- Trends in the transportation market
- Field of actions in transport policy
- Intra- and intermodal competition
- Summary

**Learning Objectives:**

- To capture the entrepreneurial perspective on transport companies
- To appraise the intra- and intermodal competition
- To understand the regulative determinant
- To reflect trends in transportation market
- To comprehend strategic challenges, chances and fields of actions of transport companies
- To apply intermodal perspective
- To take important key figures of railways and transportation market
- To realize the relevance of sustainability and digitalization
Organizational issues
Die Blockvorlesung „Die Eisenbahn im Verkehrsmarkt“ findet am 10. / 11. / 12.06.2021 von 09:00 bis 16:00 Uhr online statt. Die Prüfung findet am 05.07.2021 in Präsenz statt.
Näheres siehe Homepage http://www.fast.kit.edu/bst/929.php

Literature
keine
7.197 Course: Reliability Engineering 1 [T-MACH-107447]

Responsible: Dr.-Ing. Alexei Konnov
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102817 - Major Field: Information Technology
          M-MACH-102838 - Major Field: Energy Converting Engines

Type
Written examination

Credits 3

Grading scale Grade to a third

Recurrence Each winter term

Version 1

Competence Certificate
written exam

Prerequisites
none
## 7.198 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

<table>
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### Events

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<td>Lecture</td>
<td>3/1 SWS</td>
<td>Grade to a third</td>
<td>Each winter term</td>
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</table>

**Asfour**

### Exams

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<th>Event</th>
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<th>Description</th>
<th>Type</th>
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<tbody>
<tr>
<td>ST 2021</td>
<td>7500218</td>
<td>Robotik I - Einführung in die Robotik</td>
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<tr>
<td>WT 21/22</td>
<td>7500106</td>
<td>Robotics I - Introduction to Robotics</td>
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</tr>
</tbody>
</table>

**Asfour**

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
7.199 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

**Type**  
Oral examination  

**Credits**  
4  

**Grading scale**  
Grade to a third  

**Recurrence**  
Each winter term  

**Version**  
2

### Events

<table>
<thead>
<tr>
<th>Events</th>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
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<tr>
<td>WT 21/22</td>
<td>Oral examination</td>
<td>4</td>
<td>Grade to a third</td>
<td>Each winter term</td>
<td>2</td>
</tr>
</tbody>
</table>

**Safety Engineering**

**2117061, WS 21/22, 2 SWS, Language: German, Open in study portal**

**Lecture (V)**

**On-Site**

### Competence Certificate

The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

### Prerequisites

none

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

#### Safety Engineering

**2117061, WS 21/22, 2 SWS, Language: German, Open in study portal**

**Lecture (V)**

**On-Site**

### Content

#### Media

Presentations

#### Learning content

The course provides basic knowledge of safety engineering. In particular, the basics of health at the working place, job safety in Germany, national and European safety rules and the basics of safe machine design are covered. The implementation of these aspects will be illustrated by examples of material handling and storage technology. This course focuses on: basics of safety at work, safety regulations, basic safety principles of machine design, protection devices, system security with risk analysis, electronics in safety engineering, safety engineering for storage and material handling technique, electrical dangers and ergonomics. So, mainly, the technical measures of risk reduction in specific technical circumstances are covered.

#### Learning goals

The students are able to:

- Name and describe relevant safety concepts of safety engineering,
- Discuss basics of health at work and labour protection in Germany,
- Evaluate the basics for the safe methods of design of machinery with the national and European safety regulations and
- Realize these objectives by using examples in the field of storage and material handling systems.

### Recommendations

None

### Workload

Regular attendance: 21 hours  
Self-study: 99 hours

### Note

Dates: See IFL-Homepage

### Organizational issues

Termine: siehe ILIAS/IFL-Homepage

### Literature

Defren/Wickert: Sicherheit für den Maschinen- und Anlagenbau, Druckerei und Verlag: H. von Ameln, Ratingen
**7.200 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

<table>
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<th>Recurrence</th>
<th>Version</th>
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<tr>
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<td>Each winter term</td>
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**Events**

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<th>Grading scale</th>
<th>Recurrence</th>
<th>Organisation</th>
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<tr>
<td>WT 21/22</td>
<td>Scientific computing for Engineers</td>
<td>2 SWS</td>
<td>Lecture / Online</td>
<td>Weygand, Gumbsch</td>
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<tr>
<td>WT 21/22</td>
<td>Exercises for Scientific Computing for Engineers</td>
<td>2 SWS</td>
<td>Practice / Online</td>
<td>Weygand</td>
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**Exams**

<table>
<thead>
<tr>
<th>Exams</th>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
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<tr>
<td>ST 2021</td>
<td>Scientific Computing for Engineers</td>
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<td>Weygand, Gumbsch</td>
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<tr>
<td>WT 21/22</td>
<td>Scientific Computing for Engineers</td>
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<td>Weygand, Gumbsch</td>
</tr>
</tbody>
</table>

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

**Competence Certificate**

Written exam (90 minutes)

**Prerequisites**

The brick can not be combined with the brick "Application of advanced programming languages in mechanical engineering" (T-MACH-105390).

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

<table>
<thead>
<tr>
<th>Event</th>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2181738, WS 21/22</td>
<td>Scientific computing for Engineers</td>
<td>2 SWS</td>
<td>Lecture / Online</td>
<td>Weygand, Gumbsch</td>
<td></td>
</tr>
</tbody>
</table>

**Legend:** 🖥 Online
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 21/22, 2 SWS, Language: German, Open in study portal

Content
Exercises for the different topics of the lecture "Scientific computing for Engineers" (2181738)
regular attendance: 22.5 hours

Organizational issues
Veranstaltungsort (RZ Pool Raum) wird in Vorlesung bekannt gegeben

Literature
Skript zur Vorlesung "Wissenschaftliches Programmieren für Ingenieure" (2181738)
7.201 Course: Selected Applications of Technical Logistics [T-MACH-102160]

**Responsible:** Viktor Milushev  
Dr.-Ing. Martin Mittwollen  

**Organisation:** KIT Department of Mechanical Engineering  

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

<table>
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<td>Each summer term</td>
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<td>Each summer term</td>
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**Exams**  

- **ST 2021**  
  - 76-T-MACH-102160 Selected Applications of Technical Logistics  
  - 3 SWS  
  - Lecture / X  
  - Mittwollen

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

**Prerequisites**  
none

**Recommendation**  
Knowledge out of Basics of Technical Logistics I (T-MACH-109919) / Elements and Systems of Technical Logistics (T-MACH-102159) preconditioned.

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

**Selected Applications of Technical Logistics**  
2118087, SS 2021, 3 SWS, Language: German, Open in study portal  

**Content**  
- design and dimension of machines from intralogistics  
- static and dynamic behaviour  
- operation properties and specifics  
- Inside practical lectures: sample applications and calculations in addition to the lectures

**Details according schedule will be published**

**Organizational issues**  
Die Erfolgskontrolle erfolgt in Form einer mündlichen (20min.) Prüfung (nach §4 (2), 2 SPO). Die Prüfung wird in jedem Semester angeboten und kann zu jedem ordentlichen Prüfungstermin wiederholt werden.

The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Es werden inhaltliche Kenntnisse aus der Veranstaltung „Grundlagen der Technischen Logistik-I“ (LV 2117095) vorausgesetzt Knowledge out of Basics of Technical Logistics-I preconditioned

**Literature**  
Empfehlungen in der Vorlesung
### 7.202 Course: Selected Applications of Technical Logistics - Project [T-MACH-108945]

**Responsible:** Viktor Milushev  
Dr.-Ing. Martin Mittwollen  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102821 - Major Field: Technical Logistics

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### Events

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<td>Selected Applications of Technical Logistics - Project</td>
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<td>Mittwollen</td>
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### Exams

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<th>Title</th>
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<tr>
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<td>76-T-MACH-108945</td>
<td>Selected Applications of Technical Logistics - Project</td>
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<td>Mittwollen</td>
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</tbody>
</table>

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

### Competence Certificate

Presentation of performed project and defense (30 min) according to §4 (2), No. 3 of the examination regulation.

### Prerequisites

T-MACH-102160 (selected applications of technical logistics) must have been started.

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-102160 - Selected Applications of Technical Logistics must have been started.

### Recommendation

Knowledge out of Basics of Technical Logistics I (T-MACH-109919) / Elements and Systems of Technical Logistics (T-MACH-102159) preconditioned.

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

### Organizational issues

Ort und Zeit: siehe ILIAS / Homepage / Infos in der Veranstaltung

### Literature

Empfehlungen in der Vorlesung


**7.203 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

**Events**

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<th>Recurrence</th>
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<td>Selected Problems of Applied Reactor Physics and Exercises</td>
<td>2 SWS</td>
<td>Lecture / 🖥</td>
<td>Dagan, Metz</td>
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<td>2 SWS</td>
<td>Lecture / 🖥</td>
<td>Dagan</td>
<td></td>
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<tr>
<td>WT 21/22</td>
<td>76-T-MACH-105462</td>
<td>Selected Problems of Applied Reactor Physics and Exercises</td>
<td>2 SWS</td>
<td>Lecture / 🖥</td>
<td>Dagan, Metz</td>
</tr>
</tbody>
</table>

**Competence Certificate**

oral exam, approx. 1/2 hour

**Prerequisites**

none

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

**Selected Problems of Applied Reactor Physics and Exercises**  
2190411, SS 2021, 2 SWS, Language: German/English, Open in study portal

**Content**

- Nuclear energy and forces  
- Radioactive decay  
- Nuclear processes  
- Fission and the importance of delayed neutrons  
- Basics of nuclear cross sections  
- Principles of chain reaction  
- Static theory of mono energetic reactors  
- Introduction to reactor kinetic  
- student laboratory

The students

- have solid understanding of the basic reactor physics  
- are able to estimate processes of growth and decay of radionuclides; out of it, they can perform dose calculation and introduce their biological hazards  
- can calculate the relationship of basic parameters which are needed for a stable reactor operation  
- understand important dynamical processes of nuclear reactors.

Regular attendance: 26 h  
self study 94 h  
oral exam about 30 min.

**Literature**

K. Wirtz Grundlagen der Reaktortechnik Teil I, II, Technische Hochschule Karlsruhe 1966  
J. Duderstadt and L. Hamilton, Nuclear reactor Analysis, J. Wiley $ Sons, Inc. 1975 (in English)
7.204 Course: Self-Booking-BSc-HOC-SPZ-ZAK-Graded [T-MACH-111685]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102576 - Key Competences

<table>
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<td>Grade to a third</td>
<td>Each term</td>
<td>1</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 aquired 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".

Bachelor Program Mechanical Engineering . Date: 15/09/2021
Module Handbook valid from Winter Term 21/22
7.205 Course: Self-Booking-BSc-HOC-SPZ-ZAK-Non-Graded [T-MACH-111684]

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

**Part of:** M-MACH-102576 - Key Competences

### Competence Certificate
Completed coursework

### Prerequisites
None

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

- House of Competence
- Sprachenzentrum
- 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".
7.206 Course: Seminar for Rail System Technology [T-MACH-108692]

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

**Part of:** M-MACH-102638 - Major Field: Rail System Technology

<table>
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<tr>
<th>Events</th>
<th>Occurrence</th>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<tr>
<td>ST 2021</td>
<td>2115009</td>
<td>Seminar for Rail System Technology</td>
<td>1 SWS</td>
<td>Seminar / 🕒</td>
<td>Each term</td>
<td>2</td>
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<tr>
<td>WT 21/22</td>
<td>2115009</td>
<td>Seminar for Rail System Technology</td>
<td>1 SWS</td>
<td>Seminar / 🕒</td>
<td>Each term</td>
<td>2</td>
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</thead>
<tbody>
<tr>
<td>ST 2021</td>
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<tr>
<td>WT 21/22</td>
</tr>
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</table>

Legend: 🕒 Online, 🚭 Blended (On-Site/Online), 🖥 On-Site, ☢ Canceled

**Competence Certificate**
Examination: Writing a Seminararbeit, final presentation

**Prerequisites**
none

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

**Seminar for Rail System Technology**
2115009, SS 2021, 1 SWS, Language: German, Open in study portal

**Content**
1. Railway System: railway as a system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. System structure of railway vehicles: structure and major systems of rail vehicles
4. Scientific working: structuring and writing of scientific papers, literature research, scheduling (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 Prüfung besteht aus einer schriftlichen Ausarbeitung (Seminararbeit) und einem Vortrag über die Ausarbeitung. Weitere Infos siehe Institutshomepage.
Max. 10 participants. Examination: Writing a Seminararbeit, final presentation. Please check the homepage for further information.
Contents

- Railway system: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact, history, challenges and future developments in the context of mega trends
- Operation: Transportation, public/regional/long-distance transport, freight service, scheduling
- System structure of railway vehicles: Tasks and classification, main systems
- Project management: definitions, project management, main and side processes, transfer to practice
- Scientific working: structuring and writing of scientific papers, literature research, scheduling (mile stones), self-management, presentation skills, using the software Citavi for literature and knowledge management, working with templates in Word, giving and taking feedback
- The learnt knowledge regarding scientific writing is used to elaborate a Seminararbeit. To this the students create a presentation, train and reflect it and finally present it to an auditorium.

Organizational issues
Teilnehmerzahl ist auf 10 begrenzt. Die Prüfung besteht aus einer schriftlichen Ausarbeitung (Seminararbeit) und einem Vortrag über die Ausarbeitung. Weitere Infos siehe Institutshomepage.
Max. 10 participants. Examination: Writing a Seminararbeit, final presentation. Please check the homepage for further information.

Literature
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.
A bibliography is available for download (Ilias-platform).
7.207 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

<table>
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<th>Recurrence</th>
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<td>Each winter term</td>
<td>1 terms</td>
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**Events**

| WT 21/22 | 2302109 | Signals and Systems | 2 SWS | Lecture | Heizmann |

**Exams**

| ST 2021 | 7302109 | Signals and Systems | Heizmann |

**Prerequisites**

none
7.208 Course: Simulation of Coupled Systems [T-MACH-105172]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Yusheng Xiang

Organisation: KIT Department of Mechanical Engineering

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

<table>
<thead>
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Events

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<td>Simulation of Coupled Systems</td>
<td>2 SWS</td>
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Legend: Online, 🕺 Blended (On-Site/Online), On-Site, ✗ Cancelled

Competence Certificate

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

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

Prerequisites

Required for the participation in the examination is the preparation of a report during the semester. The partial service with the code T-MACH-108888 must have been passed.

Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-108888 - Simulation of Coupled Systems - Advance must have been passed.

Recommendation

- Knowledge of ProE (ideally in actual version)
- Basic knowledge of Matlab/Simulink
- Basic knowledge of dynamics of machnies
- Basic knowledge of hydraulics

Annotation

After completion of course, students are able to:

- build a coupled simulation
- parametrize models
- perform simulations
- conduct troubleshooting
- check results for plausibility

The number of participants is limited.

Content:

- Basics of multi-body and hydraulics simulation programs
- Possibilities of coupled simulations
- Modelling and Simulation of Mobile Machines using a wheel loader
- Documentation of the result in a short report

Literature:

Software guide books (PDFs)
Information about wheel-type loader specifications
Below you will find excerpts from events related to this course:

**Simulation of Coupled Systems**
2114095, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

### Content

- Knowledge of the basics of multi-body and hydraulic simulation programs
- Possibilities of coupled simulations
- Development of a simulation model by using the example of a wheel loader
- Documentation of the result in a short report

It is recommended to have:

- Knowledge of ProE (ideally in current version)
- Basic knowledge of Matlab/Simulink
- Basic knowledge of dynamics of machines
- Basic knowledge of hydraulics
- regular attendance: 21 hours
- total self-study: 92 hours

### Literature

**Weiterführende Literatur:**

- Diverse Handbücher zu den Softwaretools in PDF-Form
- Informationen zum verwendeten Radlader
7.209 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

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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

**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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**Exams**

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

**Competence Certificate**

oral exam of about 30 minutes

**Prerequisites**

none

**Recommendation**

Literature


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

**Solar Thermal Energy Systems**

2189400, WS 21/22, 2 SWS, Language: English, Open in study portal
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
7.211 Course: Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example [T-MACH-110961]

Responsible: Dr. Rudolf Maier
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102576 - Key Competences

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Maier

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

Competence Certificate
alternative achievement (ungraded):
- attendance on at least 12 lecture units

Prerequisites
T-MACH-106375 – The Value Stream in an Industrial Company - The Value Chain at BOSCH as an Example must not have been started.

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

Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example
2149663, WS 21/22, 2 SWS, Language: German, Open in study portal

Seminar (S) Blended (On-Site/Online)
Content
The seminar provides an insight into the main functional units of a company and their typical processes by using Bosch as an example. Furthermore it is based on discussions with the students. Former Bosch top managers explain the essential business processes and functions of the individual departments as well as the classic tasks of an engineer in a worldwide operating automotive supplier. The seminar also provides an insight into the careers of the Bosch directors. In addition to the company processes, the seminar will therefore focus on reports of challenges, successes, failures and product and process innovations.

The topics are as follows:

- Introduction, strategy, innovation
- R&D, product development process
- Production
- Quality management
- Market, marketing, sales
- Aftermarket, service
- Finance, controlling
- Logistics
- Purchasing, supply chain
- IT
- HR, leadership, compliance

Learning Outcomes:
The students ...

- are able to deduce, understand and assess the structure of a global operating enterprise.
- are capable to identify and compare the work flows and processes within a global operating enterprise.
- are able to recognize and assess the problems within interfaces between functional and organizational units which are identified by the experts. Furthermore the students can develop solutions based on this knowledge in order to overcome these problems.

Workload:
regular attendance: 21 hours
self-study: 39 hours

Organizational issues
Start: 20.10.2021
Die Anmeldung zum Seminar erfolgt über Ilias. (https://ilias.studium.kit.edu/)
Das Passwort wird im ersten Termin bekanntgegeben.
The registration for the seminar is via Ilias. (https://ilias.studium.kit.edu/)
The password will be announced in the first appointment.

Literature
Skript zur Veranstaltung wird über
(https://ilias.studium.kit.edu/) bereitgestellt.
Lecture notes will be provided in Ilias
(https://ilias.studium.kit.edu/).
7 COURSES  
Course: Strategic Product Development - Identification of Potentials of Innovative Products [T-MACH-105696]

7.212 Course: Strategic Product Development - Identification of Potentials of Innovative Products [T-MACH-105696]

Responsible: Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Sven Matthiesen  
Dr.-Ing. Andreas Siebe

Organisation: KIT Department of Mechanical Engineering

Part of:  
M-MACH-102812 - Major Field: Powertrain Systems  
M-MACH-102815 - Major Field: Engineering Design  
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 in small groups (30 minutes)

Prerequisites

The precondition of this partial work is the successful processing of a case study (T-MACH-110396): Documentation and presentation of the overall results (15 minutes)

Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-110396 - Strategic Product Development - Identification of Potentials of Innovative Products - Case Study must have been passed.

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

Strategic product development - identification of potentials of innovative products  
2146198, SS 2021, 2 SWS, Language: German, Open in study portal

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
Course: Strategic Product Development - Identification of Potentials of Innovative Products - Case Study [T-MACH-110396]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Dr.-Ing. Andreas Siebe

Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-102812 - Major Field: Powertrain Systems
- M-MACH-102815 - Major Field: Engineering Design
- M-MACH-102818 - Major Field: Vehicle Technology

**Events**

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**Exams**

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

**Competence Certificate**

Successful processing of a case study (T-MACH-110396): documentation and presentation of the overall results (15 minutes)

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

**V Strategic product development - identification of potentials of innovative products**

2146198, SS 2021, 2 SWS, Language: German, Open in study portal

**Content**

Introduction into future management, Development of scenarios, 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
### 7.214 Course: Structural Analysis of Composite Laminates [T-MACH-105970]

**Responsible:** Dr.-Ing. Luise Kärger

**Organisation:** KIT Department of Mechanical Engineering

**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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**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

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


7 COURSES

7.215 Course: Sustainable Product Engineering [T-MACH-105358]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Dr. Karl-Friedrich Ziegahn

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-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

| ST 2021 | 2146192 | Sustainable Product Engineering | 2 SWS | Lecture / Online | Ziegahn |

Exams

| ST 2021 | 76-T-MACH-105358 | Sustainable Product Engineering | Ziegahn, Albers |

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

Competence Certificate

written exam (60 min)

Prerequisites

none

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

**Sustainable Product Engineering**

2146192, SS 2021, 2 SWS, Open in study portal

Lecture (V)

Online

Content

understanding of sustainability objectives and their role in product development, the interaction between technical products and their environment, the holistic approach and the equality of economic, social and environmental aspects and environmental aspects

skills for life-cycle product design using the example of complex automotive components such as airbag systems and other current products

understanding of product environmental stresses with relevancy to praxis at the example of technology-intensive components, robustness and durability of products as the basis for a sustainable product development, development of skills for the application of environmental simulation during the process of development of technical products

delivery of key skills such as team skills / project / self / presentation based on realistic projects

The goal of the lecture is to convey the main elements of sustainable product development in the economic, social and ecological context.

The students are able to ...

- identify 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.
Organizational issues
Die zusätzliche Vorlesungstermine für Blockvorlesung finden in Räumen des IPEKs statt.
26. Mai 2020 – Blockvorlesung von 9:00 bis 17:00 Uhr
16. Juni 2020 – Blockvorlesung von 9:00 bis 17:00 Uhr
22. Juni 2020 – Blockvorlesung 14:00h-17:00h
Weitere Info siehe IPEK-Homepage
https://www.ipek.kit.edu/70_2831.php
7.216 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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Exams

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

Competence Certificate
oral exam (20 minutes)

Prerequisites
none

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

Sustainable Vehicle Drivetrains
2133132, WS 21/22, 2 SWS, Open in study portal

Content
History
Infrastructure
Market Situation
Legislation
Alternative Fuels
Innovative Drivetrains
Hybrids
Plug-In Hybrids
BEV
Fuel Cells
7.217 Course: System Integration in Micro- and Nanotechnology [T-MACH-105555]

**Responsible:** Dr. Ulrich Gengenbach  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102820 - Major Field: Mechatronics

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**Exams**

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</table>

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

**Code:** 2106033, **SS 2021**, 2 SWS, **Language:** German, [Open in study portal](#)

**Lecture (V)**  
**Online**

**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
7.218 Course: System Integration in Micro- and Nanotechnology 2 [T-MACH-110272]

- **Responsible:** Dr. Ulrich Gengenbach
- **Organisation:** KIT Department of Mechanical Engineering
- **Part of:** M-MACH-102820 - Major Field: Mechatronics

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<td>Grade to a third</td>
<td>Each winter term</td>
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**Legend:** 🔄 Online, 🎤 Blended (On-Site/Online), 🗄 On-Site, ✗ Cancelled

**Competence Certificate**
Oral exam, approx. 15 min.

**Prerequisites**
None

**Annotation**
Attention: The lecture and exam will be offered for the first time in WS20/21!

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

**System Integration in Micro- and Nanotechnology 2**
2105040, WS 21/22, 2 SWS, Language: German, [Open in study portal](#

**Content**
Introduction to system integration (novel processes and applications)
Assembly of hybrid microsystems
Packaging processes
Applications:
- Micro process engineering
- Lab-on-chip systems
- Microoptical systems
- Silicon Photonics

Novel integration processes:
- Direct Laser Writing
- Self Assembly

**Learning objectives**
The students acquire knowledge of novel system integration technologies and their application in microoptic and microfluidic systems.

**Literature**
N.-T. Nguyen, Fundamentals and Applications of Microfluidics, Artech House
G. T. Reed, Silicon Photonics: An Introduction, Wiley
7.219 Course: Systematic Materials Selection [T-MACH-100531]

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

**Organisation:** KIT Department of Mechanical Engineering

### Events

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<td>Systematic Materials Selection</td>
<td>Lecture</td>
<td>3 SWS</td>
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<td>ST 2021</td>
<td>2174577</td>
<td>Übungen zu 'Systematische Werkstoffauswahl'</td>
<td>Practice</td>
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**Exams**

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<td>Lecture</td>
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</table>

**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 2021, 3 SWS, Language: German, [Open in study portal](#)
Content
Important aspects and criteria of materials selection are examined and guidelines for a systematic approach to materials selection are developed. The following topics are covered:

- Information and introduction
- Necessary basics of materials
- Selected methods / approaches of the material selection
- Examples for material indices and materials property charts
- Trade-off and shape factors
- Sandwich materials and composite materials
- High temperature alloys
- Regard of process influences
- Material selection for production lines
- Incorrect material selection and the resulting consequences
- Abstract and possibility to ask questions

Learning objectives:
The students are able to select the best material for a given application. They are proficient in selecting materials on base of performance indices and materials selection charts. They can identify conflicting objectives and find sound compromises. They are aware of the potential and the limits of hybrid material concepts (composites, bimaterials, foams) and can determine whether following such a concept yields a useful benefit.

Requirements:
Wiling SPO 2007 (B.Sc.)
The course Material Science I [21760] has to be completed beforehand.

Wiling (M.Sc.)
The course Material Science I [21760] has to be completed beforehand.

Workload:
The workload for the lecture is 120 h per semester and consists of the presence during the lecture (30 h) as well as preparation and rework time at home (30 h) and preparation time for the oral exam (60 h).

Literature
Vorlesungsskriptum; Übungblätter; Lehrbuch: M.F. Ashby, A. Wanner (Hrsg.), C. Fleck (Hrsg.); Materials Selection in Mechanical Design: Das Original mit Übersetzungshilfen Easy-Reading-Ausgabe, 3. Aufl., Spektrum Akademischer Verlag, 2006
ISBN: 3-8274-1762-7

Lecture notes; Problem sheets; Textbook: M.F. Ashby, A. Wanner (Hrsg.), C. Fleck (Hrsg.); Materials Selection in Mechanical Design: Das Original mit Übersetzungshilfen Easy-Reading-Ausgabe, 3. Aufl., Spektrum Akademischer Verlag, 2006
ISBN: 3-8274-1762-7
Course: Technical Acoustics [T-MACH-111382]

Responsible: Dr. Iris Pantle
Johannes Walter

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102815 - Major Field: Engineering Design
M-MACH-102816 - Major Field: Fundamentals of Energy Technology

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<td>Pritz, Walter, Pantle</td>
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Exams

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<td>3</td>
<td>Pantle, Walter</td>
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<td>3</td>
<td>Pantle, Walter</td>
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</table>

Competence Certificate

oral exam, 30 min.

Prerequisites

None

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

Technical Acoustics

2158107, SS 2021, 2 SWS, Language: German, Open in study portal

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

Content

Basics of acoustics
Perception and weighting of noise (human hearing)
Description of acoustic parameters, level notation
Noise propagation
Acoustical measurement techniques
regular attendance: 28 hours
self-study: 60 hours
preparation for exam: 30 hours
Oral examination
Duration: 30 minutes

No tools or reference materials may be used during the exam.

WARNING for ETIT students: the recognition is not possible because the Faculty of Electrical Engineering and Information Technology also offers a "Technical Acoustics" course.

Students get to know the basics of technical acoustics in general. Application of the knowledge in different fields of engineering.
Students learn physical basics of acoustics and human perception. Physical-empirical laws for determination of sound and noise levels of various emission and immission situations will be worked out or derived. Furtheron general sound measurement methods of machinery will be taught.

Students are able to understand mechanisms of sound origin, propagation and reduction, as well as measuring technics

Literature

1. Vorlesungsskript (von Homepage des Instituts herunterladbar).
## 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

### Type
- Written examination

### Credits
4

### Grading scale
Grade to a third

### Recurrence
Each summer term

### Version
1

### Events

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<th>Technical Design in Product Development</th>
<th>2 SWS</th>
<th>Lecture / 🗿</th>
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### Exams

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<th>Technical Design in Product Development (Test Karlsruhe)</th>
<th>Schmid, Albers</th>
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</table>

Legend: 🗿 Online, 🎥 Blended (On-Site/Online), 🌟 On-Site, ✗ Cancelled

### Competence Certificate
- Written exam (60 min)
- Only dictionary is allowed

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

#### Technical Design in Product Development
2146179, SS 2021, 2 SWS, Language: German, Open in study portal

### Content

**Introduction**

- Relevant parameters on product value in Technical Design
- Design in Methodical Development and Engineering and for a differentiated validation of products
- Design in the concept stage of Product Development
- Design in the draft and elaboration stage of Product Development

**Best Practice**

- After listening the module "technical design" the students should have knowledge about the basics of technical oriented design as an integral part of the methodical product development

- The students have knowledge about ...
  - the interface between engineer and designer.
  - all relevant human-product requirements as f. exp. demographic/ geographic and psychographic features, relevant perceptions, typical content recognition as well as ergonomic bases.
  - the approaches concerning the design of a product, product program or product system with focus on structure, form-, color- and graphic design within the phases of the design process.
  - the design of functions and supporting structures as well as the important interface between human and machine.
  - relevant parameters of a good corporate design.

### Organizational issues


Erster Vorlesungstermin: wird noch bekanntgegeben
Literature
Markus Schmid, Thomas Maier
Technisches Interface Design
Anforderungen, Bewertung, Gestaltung.
2017
Hartmut Seeger
Design technischer Produkte, Produktprogramme und -systeme
Industrial Design Engineering.
2. , bearb. und erweiterte Auflage.
ISBN: 3540236538
September 2005 - gebunden - 396 Seiten
### 7.222 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>4 SWS</td>
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<td>4 SWS</td>
<td>Lecture / Blended</td>
<td>Schießl, Maas</td>
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**Exams**  
| ST 2021         | 76-T-MACH-104747  | Technical Thermodynamics and Heat Transfer I | Maas |
| ST 2021         | 76-T-MACH-104747-englisch | Technical Thermodynamics and Heat Transfer I | Maas |
| WT 21/22        | 76-T-MACH-104747  | Technical Thermodynamics and Heat Transfer I | Maas |

**Competence Certificate**  
Prerequisite: attestation each semester by homework assignments

**Prerequisites**  
Successful participation in the tutorial (T-MACH-105204 - Excercises in Technical Thermodynamics and Heat Transfer I)

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

1. The course T-MACH-105204 - Excercises in Technical Thermodynamics and Heat Transfer I must have been passed.

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

#### Technical Thermodynamics and Heat Transfer I

2165501, WS 21/22, 4 SWS, Language: German, [Open in study portal](#)

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

**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 21/22, 4 SWS, Language: English, Open in study portal

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

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


### 7.223 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

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<td>Technical Thermodynamics and Heat Transfer II</td>
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<td>Lecture</td>
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**Legend:** 
- 🖥 Online
- 🧩 Blended (On-Site/Online)
- 🗣 On-Site
- ❌ Cancelled

### Competence Certificate

- **Prerequisite:** attestation each semester by homework assignments
- **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**

- Code: 2166526, SS 2021, 3 SWS, Language: German, [Open in study portal](#)
- Lecture (V): Blended (On-Site/Online)

#### 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*


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


7.224 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

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<td>Technology of steel components</td>
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**Exams**

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**Legend:** 🌐 Online, 🕰 Blended (On-Site/Online), 🧩 On-Site, ❌ Canceled

**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:**

**Technology of steel components**

2174579, SS 2021, 2 SWS, Language: German, Open in study portal

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

**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
## Course: Theoretical Description of Mechatronic Systems [T-MACH-105521]

### Responsible
Prof. Dr.-Ing. Wolfgang Seemann

### Organisation
KIT Department of Mechanical Engineering

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

### Type
Oral examination

### Credits
4

### Grading scale
Grade to a third

### Recurrence
Each winter term

### Version
1

### Events

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### Exams

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### Competence Certificate
oral exam, approx. 30 min..

### Prerequisites
none

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

#### Theoretical Description of Mechatronic Systems

2161117, WS 21/22, 2 SWS, Language: German, Open in study portal

### Content

Aim of the course is to provide principles and tools to derive the mathematical models of mechatronic systems. The students are able to generate physical models of mechatronic systems. They know the description by across and through variables. With the help of energy principles variational methods can be applied to electromechanic systems. The basics of applied mechanics and of electric systems are known. The students are able to complete the mechatronic system by a corresponding tool.

### Organizational issues

Vorlesung wird im WS 2021/22 nicht angeboten.
### 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  

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**Events**

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<td>Lecture</td>
<td>Theory of Stability</td>
<td>2</td>
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<td>Prof. Dr.-Ing. Alexander Fidlin</td>
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<td>Practice</td>
<td>Übungen zu Stabilitätstheorie</td>
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**Exams**

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

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

**Prerequisites**  
none

**Recommendation**  
Vibration theory, Mathematical Methods of Vibration Theory

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

### Theory of Stability

**2163113, SS 2021, 2 SWS, Language: German, Open in study portal**  

**Lecture (V) Online**

**Content**

- Basic concepts of stability  
- Lyapunov's functions  
- Direct lyapunov's methods  
- Stability of equilibria positions  
- Attraction area of a stable solution  
- Stability according to the first order approximation  
- Systems with parametric excitation  
- Stability criteria in the control theory

**Literature**

7.227 Course: Thermal Solar Energy [T-MACH-105225]

**Responsible:** Prof. Dr. Robert Stieglitz  
**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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Legend: 🖥 Online, 🗑 Blended (On-Site/Online), ⚗ On-Site, ❌ Cancelled

**Competence Certificate**

Oral examination of about 30 minutes

**Prerequisites**

none

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

**Thermal Solar Energy**

2169472, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V) On-Site**

---

**Content**

Basics of thermal solar energy (radiation, heat conduction, storage, efficiency...) Active and passive use of solar energy. Solar collectors (design types, efficiency, system technology). Solar plants (heliostats etc.). Solar climatisation. In detail:

1. Introduction to energy requirements and evaluation of the potential use of solar thermal energy.
2. Primary energy source SUN: sun, solar constant, radiation (direct, diffuse scattering, absorption, impact angle, radiation balance).
5. Momentum and heat transport: basic equations of single and multiphase transport, calculation methods, stability limits.
6. Low temperature solar thermal systems: collector types, methods for system simulation, planning and dimensioning of systems, system design and stagnation scenarios.
7. High temperature solar thermal systems: solar towers and solar-farm concept, loss mechanisms, chimney power plants and energy production processes.

The lecture elaborates the basics of the solar technology and the definition of the major wordings and its physical content such as radiation, thermal use, insulation etc.. Further the design of solar collectors for different purposes is discussed and analyzed. The functional principle of solar plants is elaborated before at the end the ways for solar cooling is discussed.

The aim of the course is to provide the basic physical principles and the derivation of key parameters for the individual solar thermal use. This involves in addition to the selective absorber, mirrors, glasses, and storage technology. In addition, a utilization of solar thermal energy means an interlink of the collector with a thermal-hydraulic circuit and a storage. The goal is to capture the regularities of linking to derive efficiency correlations as a function of their use and evaluate the performance of the entire system.

**Recommendations / previous knowledge**

Basics in heat and mass transfer, material science and fluid mechanics, desirable are reliable knowledge in physics in optics and thermodynamics.

Oral exam of about 25 minutes, no tools or reference materials may be used during the exam.

Bachelor Program Mechanical Engineering, Date: 15/09/2021
Module Handbook valid from Winter Term 21/22
**Organizational issues**
Die Veranstaltung wird nur online gehalten, falls durch Corona Einschränkungen vorgegeben werden.

**Literature**
Bereitstellung des Studienmaterials in gedruckter und elektronischer Form.
7 COURSES

Course: Thermal Turbomachines I [T-MACH-105363]

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

Part of: M-MACH-102838 - Major Field: Energy Converting Engines

<table>
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Exams

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

Competence Certificate
oral exam, duration 30 min.

Prerequisites
none

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

V Thermal Turbomachines I
2169453, WS 21/22, 3 SWS, Language: German, Open in study portal  Lecture (V) On-Site

Bachelor Program Mechanical Engineering . Date: 15/09/2021
Module Handbook valid from Winter Term 21/22
Content
Basic concepts of thermal turbomachinery
Steam Turbines - Thermodynamic process analysis
Gas Turbines - Thermodynamic process analysis
Combined cycle and cogeneration processes
Overview of turbomachinery theory and kinematics
Energy transfer process within a turbine stage
Types of turbines (presented through examples)
1-D streamline analysis techniques
3-D flow fields and radial momentum equilibrium in turbines
Compressor stage analysis and future trends in turbomachinery

The students are able to explain and comment on the design and operation of thermal turbomachines in detail. Moreover, they can evaluate the range of applications for turbomachinery. Therefore, students are able to describe and analyse not only the individual components but also entire assemblies. The students can assess and evaluate the effects of physical, economical and ecological boundary conditions.

regular attendance: 31,50 h
self-study: 64,40 h

Recommendations:
Recommended in combination with the lecture 'Thermal Turbomachines II'.

Examination:
oral
Duration: approximately 30 min

no tools or reference materials may be used during the exam

Organizational issues
Vorlesung findet in Präsenz statt, sofern es die COVID-Inzidenzwerte zulassen.

Literature
Vorlesungsskript (erhältlich im Internet)
Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993
Content
Basic concepts of thermal turbomachinery

Steam Turbines - Thermodynamic process analysis

Gas Turbines - Thermodynamic process analysis

Combined cycle and cogeneration processes

Overview of turbomachinery theory and kinematics

Energy transfer process within a turbine stage

Types of turbines (presented through examples)

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Recommendations:
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The students are able to explain and comment on the design and operation of thermal turbomachines in detail. Moreover, they can evaluate the range of applications for turbomachinery. Therefore, students are able to describe and analyse not only the individual components but also entire assemblies. The students can assess and evaluate the effects of physical, economical and ecological boundary conditions.

regular attendance: 31,50 h
self-study: 64,40 h

Exam:
oral
Duration: approximately 30 min

no tools or reference materials may be used during the exam

Organizational issues
Veranstaltung wird in Präsenz angeboten, sofern es die COVID-Inzidenzwerte zulassen

Literature
Vorlesungsskript (erhältlich im Internet)


Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993

### 7.229 Course: Thermal Turbomachines II [T-MACH-105364]

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

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

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<td>2 SWS Practice / 📚</td>
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**Exams**

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

**Competence Certificate**

oral exam, duration: 30 min.

**Prerequisites**

none

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

### Thermal Turbomachines II

2170476, SS 2021, 3 SWS, Language: German, [Open in study portal](#)
Content
General overview, trends in design and development

Comparison turbine - compressor

Integrating resume of losses

Principal equations and correlations in turbine and compressor design, stage performance

Off-design performance of multi-stage turbomachines

Control system considerations for steam and gas turbines

Components of turbomachines

Critical components

Materials for turbine blades

Cooling methods for turbine blades (steam and air cooling methods)

Short overview of power plant operation

Combustion chamber and environmental issues

Based on the fundamental skills learned in 'Thermal Turbomachines I' the students have the ability to design turbines and compressors and to analyse the operational behavior of these machines.

Recommendations:
Recommended in combination with the lecture 'Thermal Turbomachines I'.

regular attendance: 31.50 h
self-study: 64.40 h

Exam:
oral (can only be taken in combination with 'Thermal Turbomachines I')
Duration: 30 min (→ 1 hour including Thermal Turbomachines I)

Auxiliary: no tools or reference materials may be used during the exam

Literature
Vorlesungsskript (erhältlich im Internet)
Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993

Thermal Turbomachines II (in English)
2170553, SS 2021, 3 SWS, Language: English, Open in study portal
Content
Basic concepts of thermal turbomachinery
Steem 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
### 7.230 Course: Tires and Wheel Development for Passenger Cars [T-MACH-102207]

**Responsible:** Hon.-Prof. Dr. Günter Leister  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102818 - Major Field: Vehicle Technology

<table>
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**Events**

| ST 2021 | 2114845 | Tires and Wheel Development for Passenger Cars | 2 SWS | Lecture / 🖥 | Leister |

**Exams**

| ST 2021 | 76-T-MACH-102207 | Tires and Wheel Development for Passenger Cars | Leister |
| WT 21/22 | 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 2021, 2 SWS, Language: German, [Open in study portal](#)

**Content**

1. The role of the tires and wheels in a vehicle
2. Geometric 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 presssure: Indirect and direct measuring systems
8. Tire testing subjective and objective

**Learning Objectives:**

The students are informed about the interactions of tires, wheels and chassis. They have an overview of the processes regarding the tire and wheel development. They have knowledge of the physical relationships.

**Organizational issues**

Voraussichtliche Termine, nähere Informationen und eventuelle Terminänderungen: siehe Institutshomepage.

**Literature**

Manuskript zur Vorlesung  
Manuscript to the lecture
7.231 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

<table>
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**Events**

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**Legend:**  🖥 Online, 🧩 Blended (On-Site/Online),  Blasio,  ❗ 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:

**Tribology**

2181114, WS 21/22, 5 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**

Online
Content

- Chapter 1: Friction
  adhesion, geometrical and real area of contact, Friction experiments, friction powder, tribological stressing, environmental influences, tribological age, contact models, Simulation of contacts, roughness.
- Chapter 2: Wear
  plastic deformation at the asperity level, dissipation modes, mechanical mixing, Dynamics of the third body, running-in, running-in dynamics, shear stress.
- Chapter 3: Lubrication
  base oils, 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

7.232 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

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

Competence Certificate
oral exam, appr. 20 min

Prerequisites
none
# 7.233 Course: Turbo Jet Engines [T-MACH-105366]

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

**Part of:** M-MACH-102838 - Major Field: Energy Converting Engines

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**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

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**Competence Certificate**  
oral exam, duration: 20 min.

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### Prerequisites

none

---

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

**Turbo Jet Engines**  
2170478, SS 2021, 2 SWS, Language: German, [Open in study portal](#)  
Lecture (V)  
Blended (On-Site/Online)

---

### Content

Introduction to jet engines and their components

Demands on engines and propulsive efficiency

Thermodynamic and gas dynamic fundamentals and design calculations

Components of air breathing engines

Jet engine design and development process

Engine and component design

Current developments in the jet engines industry

The students have the ability to:

- compare the design concepts of modern jet engines
- analyse the operation of modern jet engines
- apply the thermodynamic and fluidmechanic basics of jet engines
- choose the main components intake, compressor, combustor, turbine and thrust nozzle based on given criteria
- comment on different methods for the reduction of pollutant emissions, noise and fuel consumption

---

**Regular attendance:** 21 h

**Self-study:** 42 h

**Exam:**

oral

Duration: approximately 30 minutes

**Tools or reference materials:** 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
7.234 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.
**T**

### 7.235 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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Legend: 🖥️ Online, 🖥️ Blended (On-Site/Online), 🗣️ On-Site, 🗿 Cancelled

**Competence Certificate**
Learning assessment is carried out by written assignments (pre-requisite). Exact requirements will be communicated in the lectures.

**Prerequisites**
None.
### 7.236 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.

**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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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), ⚹ On-Site, ☓ Cancelled

**Competence Certificate**

Successfully passing the Tutorial is a prerequisite for taking part in the exam "Continuum Mechanics of Solids and Fluids" (T-MACH-110377).

For students of Mechanical Engineering (BSc) that have chosen the Major Field "Continuum Mechanics" and for students of Material Science and Material Technology (BSc) the prerequisites consist of successfully solving the written homework sheets as well as the computational homework sheets during the associated computer tutorials.

For students of Mechanical Engineering that have chosen a different Major Field of 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**

2161253, WS 21/22, 1 SWS, Language: German, Open in study portal

**Practice (Ü)**

Blended (On-Site/Online)

**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".
### 7.238 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

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**Legend:** 🖥 Online, 🔄 Blended (On-Site/Online), 🗂 On-Site, ⚪ Cancelled

### Competence Certificate

Attestations have to be achieved in the following four categories: mandatory written homework problems, written homework problems, computational homework problems, colloquia.

This course is passed if all mandatory written homework problems are passed and if in the other three categories (written homework problems, computational homework problems, colloquia) in total at most three attestations have been finally not passed, at most one in each of the three categories.

Successful participation in this course allows for registration 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 21/22, 2 SWS, Language: German, Open in study portal  

**Practice (Ü)**  
Blended (On-Site/Online)

### Content

Please refer to the lecture Engineering Mechanics I.

### Literature

Siehe Vorlesung Technische Mechanik I
7.239 Course: Tutorial Engineering Mechanics II [T-MACH-100284]

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

Competence Certificate

Attestations have to be achieved in the following four categories: mandatory written homework problems, written homework problems, computational homework problems, colloquium.

This course is passed if all mandatory written homework problems are passed and if in the other three categories (written homework problems, computational homework problems, colloquium) in total at most two attestations have been finally not passed, at most one in each of the three categories.

Successful participation in this course allows for registration to the Exam "Engineering Mechanics II" (see T-MACH-100283)

Prerequisites

None

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

**Tutorial Engineering Mechanics II**

2162251, SS 2021, 2 SWS, Language: German, Open in study portal

**Engineering Mechanics II (Tutorial)**

3162011, SS 2021, 2 SWS, Language: English, Open in study portal

- **Responsible:** Prof. Dr.-Ing. Wolfgang Seemann
- **Organisation:** KIT Department of Mechanical Engineering
- **Part of:** M-MACH-102572 - Engineering Mechanics

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

**Competence Certificate**
Attestations, successful accomplishment of exercise sheets

**Prerequisites**
None

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

**Engineering Mechanics III (Tutorial)**
2161204, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)
Practice (Ü)
Blended (On-Site/Online)

**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.

**Engineering Mechanics III (Tutorial)**
3161013, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)
Practice (Ü)
Blended (On-Site/Online)

**Content**

Exercises related to the lecture

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

**Part of:** M-MACH-102572 - Engineering Mechanics

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**Events**

| ST 2021 | 2162232 | Engineering Mechanics IV (Tutorial) | 2 SWS | Practice / 🖥 | Seemann, Luo, Schröders, Altoé |
| ST 2021 | 3162013 | Engineering Mechanics 4 (Tutorial) | 2 SWS | Practice / 🧩 | Seemann, Luo, Schröders |

**Exams**

| ST 2021 | 76-T-MACH-105203 | Tutorial Engineering Mechanics IV | Seemann |

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 2021, 2 SWS, Language: German, [Open in study portal](#)

**Practice (Ü)**

**Online**

**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
7.242 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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**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 2021, 2 SWS, Open in study portal

**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.
7.243 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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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗠 On-Site, ✗ Cancelled

**Competence Certificate**
Successful participation in this course allows for registration to the Exam "Introduction to the Finite Element Method" (see 76-T-MACH-105320)

For students of Mechanical Engineering (BSc) that have chosen the Major Field "Continuum Mechanics" the prerequisites consist of successfully solving the written homework sheets as well as the computational homework sheets during the associated computer tutorials.

For students of Mechanical Engineering that have chosen a different Major Field and for students from different fields of study the prerequisites consist of successfully solving only the written homework sheets.

**Annotation**
Knowledge of the contents of the courses "Continuum Mechanics of Solids and Fluids" and "Mathematical Methods of Continuum Mechanics" as well as the corresponding tutorials are expected.

Due to capacity reasons it is possible that not all students of this course can be admitted to the computer tutorials. Students of the bachelor's degree program in mechanical engineering who have chosen the Major Field Continuum Mechanics (SP-Nr 13) will be admitted to the computer tutorials in any case.

If additional places are available in the computer tutorials for this course, these will be allocated according to the BSc average grade.

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

**Tutorial Introduction to the Finite Element Method**
2162257, SS 2021, 1 SWS, Language: German, Open in study portal

**Practice (Ü)**
Online

**Content**
See lecture "Introduction to the Finite Element Method"

**Literature**
siehe Vorlesung "Einführung in die Finite-Elemente-Methode"
7.244 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

<table>
<thead>
<tr>
<th>Type</th>
<th>Completed coursework</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Expansion</th>
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<td>Each winter term</td>
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**Events**

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<th>Type</th>
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<td>2161255</td>
<td>Tutorial Mathematical Methods in Continuum Mechanics</td>
<td>2 SWS</td>
<td>Practice / 🧩</td>
<td>Each winter term</td>
<td>1 terms</td>
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</table>

**Böhlke**

### 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 21/22, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**

Blended (On-Site/Online)

**Content**

See "Mathematical Methods in Continuum Mechanics"

**Literature**

Siehe "Mathematische Methoden der Kontinuumsmechanik"
Competence Certificate
Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
Can not be combined with lecture T-MACH-102206

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

Content
1. Perception of noise and vibrations
2. Fundamentals of acoustics and vibrations
3. Tools and methods for measurement, computing, simulation and analysis of noise and vibrations
4. The relevance of tire and chasis for the acoustic and mechanical driving comfort: phenomena, influencing parameters, types of construction, optimization of components and systems, conflict of goals, methods of development

An excursion will give insights in the development practice of a car manufacturer or a system supplier.

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 chasis regarding driving comfort and acoustic under consideration of goal conflicts.
Organizational issues
Kann nicht mit der Veranstaltung [2113806] kombiniert werden.
Can not be combined with lecture [2113806]
Genaue Termine entnehmen Sie bitte der Institushomepage.
Scheduled dates:
see homepage of the institute.

Content
1. Perception of noise and vibrations
2. Fundamentals of acoustics and vibrations
3. Tools and methods for measurement, computing, simulation and analysis of noise and vibrations
4. The relevance of tire and chasis for the acoustic and mechanical driving comfort: phenomena, influencing parameters, types of construction, optimization of components and systems, conflict of goals, methods of development

An excursion will give insights in the development practice of a car manufacturer or a system supplier.

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 chasis regarding driving comfort and acoustic under consideration of goal conflicts.

Organizational issues
Kann nicht mit der Veranstaltung [2114856] kombiniert werden.
Can not be combined with lecture [2114856]

Literature
2. Russel C. Hibbeler, Technische Mechanik 3, Dynamik, Pearson Studium, München, 2006

Das Skript wird zu jeder Vorlesung zur Verfügung gestellt
7.246 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>
<thead>
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<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<td>Grade to a third</td>
<td>Each summer term</td>
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Events

| ST 2021 | 2114825 | Vehicle Comfort and Acoustics II | 2 SWS | Lecture / 🛬 | Gauterin |
| ST 2021 | 2114857 | Vehicle Ride Comfort & Acoustics II | 2 SWS | Lecture / 🛬 | Gauterin |

Exams

| ST 2021 | 76-T-MACH-105155 | Vehicle Comfort and Acoustics II | Gauterin |
| WT 21/22 | 76-T-MACH-105155 | Vehicle Comfort and Acoustics II | Gauterin |

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

Competence Certificate

Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites

Can not be combined with lecture T-MACH-102205

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

Vehicle Comfort and Acoustics II
2114825, SS 2021, 2 SWS, Language: German, Open in study portal

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

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 Comfort and Acoustics II
2114857, SS 2021, 2 SWS, Language: English, Open in study portal
Organizational issues
Genaue Termine entnehmen Sie bitte der Institushomepage.
Kann nicht mit der Veranstaltung [2114825] kombiniert werden.
Scheduled dates:
see homepage of the institute.
Can not be combined with lecture [2114825].

Literature
Das Skript wird zu jeder Vorlesung zur Verfügung gestellt.
The script will be supplied in the lectures.
7.247 Course: Vehicle Ergonomics [T-MACH-108374]

**Responsible:** Prof. Dr.-Ing. Barbara Deml

**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>Recurrence</th>
<th>Version</th>
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<td>Grade to a third</td>
<td>Each summer term</td>
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**Competence Certificate**
written exam, 60 minutes

**Prerequisites**
none

**Responsible:** Prof. Dr.-Ing. Frank Henning

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-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**

<table>
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<tr>
<th>Events</th>
<th>Code</th>
<th>Description</th>
<th>Type</th>
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<tr>
<td>WT 21/22</td>
<td>2113102</td>
<td>Vehicle Lightweight Design – Strategies, Concepts, Materials</td>
<td>Lecture / Blended</td>
<td>2 SWS</td>
<td>Grade to a third</td>
<td>Each winter term</td>
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**Exams**

<table>
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<tr>
<th>Exams</th>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>ST 2021</td>
<td>76-T-MACH-105237</td>
<td>Vehicle Lightweight Design - Strategies, Concepts, Materials</td>
<td>Henning</td>
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<td>WT 21/22</td>
<td>76-T-MACH-105237</td>
<td>Vehicle Lightweight Design - Strategies, Concepts, Materials</td>
<td>Henning</td>
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</table>

**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**
- Code: 2113102, WS 21/22, 2 SWS, Language: German, Open in study portal
- Type: Lecture (V), Blended (On-Site/Online)

**Content**

- **Strategies in lightweight design**
- Shape optimization, light weight materials, multi-materials and concepts for lightweight design
- **Construction methods**
- Differential, integral, sandwich, modular, bionic
- **Body construction**
- Shell, space frame, monocoque
- **Metallic materials**
- Steel, aluminium, magnesium, titan

**Aim of this lecture:**

Students learn that lightweight design is a process of realizing a demanded function by using the smallest possible mass. They understand lightweight construction as a complex optimization problem with multiple boundary conditions, involving competences from methods, materials and production. Students learn the established lightweight strategies and ways of construction. They know the metallic materials used in lightweight construction and understand the relation between material and vehicle body.
Literature
Below you will find excerpts from events related to this course:

### Vibration Theory

**V 2161212, WS 21/22, 2 SWS, Language: German, Open in study portal**

**Lecture (V)**

**Content**

Concept of vibration, superposition of vibration with equal and with different frequencies, complex frequency response.

Vibration of systems with one dof: Free undamped and damped vibration, forced vibration for harmonic, periodic and arbitrary excitation. Excitation of undamped vibration in resonance.


Vibration of systems with distributed parameters: Partial differential equations as equations of motion, wave propagation, d'Alembert's solution, Ansatz for separation of time and space, eigenvalue problem, infinite number of eigenvalues and eigenfunctions.

Introduction to rotor dynamics: Laval rotor in rigid and elastic bearings, inner damping, Laval rotor in anisotropic bearings, synchronous and asynchronous whirl, rotors with asymmetric shaft.

**Literature**

Klotter: Technische Schwingungslehre, Bd. 1 Teil A, Heidelberg, 1978

Hagedorn, Otterbein: Technische Schwingungslehre, Bd. 1 und Bd. 2, Berlin, 1987

Content
Exercises related to the lecture
## 7.250 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

<table>
<thead>
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<td>Each summer term</td>
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### Events

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<th>Course</th>
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<th>Grading scale</th>
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<td>ST 2021</td>
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<td>Virtual Engineering (Specific Topics)</td>
<td>Lecture / 🖥️</td>
<td>2 SWS</td>
<td>Lecture / 🖥️</td>
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### Exams

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<td>76-T-MACH-105381</td>
<td>Virtual Engineering (Specific Topics)</td>
<td>Ovtcharova</td>
</tr>
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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:

#### Virtual Engineering (Specific Topics)

**3122031, SS 2021, 2 SWS, Language: English, Open in study portal**

**Lecture (V) Online**

**Content**

Students can

- explain the basics of virtual engineering and name exemplary modeling tools and assign them to the corresponding methods and processes
- Formulate validation questions in the product development process and name obvious solution methods
- explain the basics of systems engineering and establish the connection to the product development process
- explain individual methods of the digital factory and present the functions of the digital factory in the context of the product creation process
- explain the theoretical and technical basics of Virtual Reality technology and show the connection to Virtual Engineering

**Organizational issues**

Vorlesungszeiten siehe ILIAS / Lecture times see ILIAS

**Literature**

Lecture slides / Vorlesungsfolien
7.251 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

<table>
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<td>Examination of another type</td>
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<td>Grade to a third</td>
<td>Each term</td>
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Events

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Exams

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<td>Project (P / 🧩)</td>
<td>Each term</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate
Assessment of another type (graded)

Prerequisites
None

Annotation
Number of participants is limited

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

Virtual Reality Practical Course
2123375, WS 21/22, 3 SWS, Language: German/English, Open in study portal

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
7.252 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

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

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

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<td>Exams</td>
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</table>

**Competence Certificate**
The success control takes place in form of a written examination (60 min) during the semester break (according to §4(2), 1 SPO). If the number of participants is low, an oral examination (according to §4 (2), 2 SPO) may also be offered.

**Prerequisites**
none

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

**Warehousing and distribution systems**

2118097, SS 2021, 2 SWS, Language: German, Open in study portal

**Literature**

ARNOLD, Dieter, FURMANS, Kai (2005)
Materialfluss in Logistiksystemen, 5. Auflage, Berlin: Springer-Verlag

ARNOLD, Dieter (Hrsg.) et al. (2008)
Handbuch Logistik, 3. Auflage, Berlin: Springer-Verlag

Warehouse Science

GUDEHUS, Timm (2005)
Logistik, 3. Auflage, Berlin: Springer-Verlag

FRAZELLE, Edward (2002)
World-class warehousing and material handling, McGraw-Hill

MARTIN, Heinrich (1999)
Praxiswissen Materialflußplanung: Transport, Hanshaben, Lagern, Kommissionieren, Braunschweig, Wiesbaden: Vieweg

WISSE, Jens (2009)
Der Prozess Lagern und Kommissionieren im Rahmen des Distribution Center Reference Model (DCRM); Karlsruhe: Universitätsverlag

Eine ausführliche Übersicht wissenschaftlicher Paper findet sich bei:

ROODBERGEN, Kees Jan (2007)
Warehouse Literature
## 7.253 Course: Wave and Quantum Physics [T-PHYS-108322]

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

**Organisation:**  
KIT Department of Physics

**Part of:**  
M-PHYS-104030 - Physics

<table>
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<td>Each summer term</td>
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### Events

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<th>Practice</th>
<th>Instructor</th>
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<td>2 SWS</td>
<td>Wellen und Quantenphysik</td>
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<td>Pilawa</td>
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<td>1 SWS</td>
<td>Übungen zu Wellen und Quantenphysik</td>
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<td>ST 2021 4040431</td>
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<td>Goll</td>
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<tr>
<td>ST 2021 4040432</td>
<td>1 SWS</td>
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### Exams

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<th>Credits</th>
<th>Lecture</th>
<th>Practice</th>
<th>Instructor</th>
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<td>Wellen und Quantenphysik (Exam in German)</td>
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<td>ST 2021 7800124</td>
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<td>Wave and Quantum Physics (Exam in English)</td>
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**Legend:**  
🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**  
Written exam (usually about 180 min)

**Prerequisites**  
none
7.254 Course: Wave Propagation [T-MACH-105443]

**Responsible:** Prof. Dr.-Ing. Wolfgang Seemann

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104442 - Major Field: Vibration Theory

<table>
<thead>
<tr>
<th>Type</th>
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<th>Grading scale</th>
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<tbody>
<tr>
<td>Oral examination</td>
<td>4</td>
<td>Grade to a third</td>
<td>Each winter term</td>
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**Events**

| WT 21/22                  | 2161219 | Wave Propagation               | 2 SWS                  | Lecture / 🧩 | Seemann |

**Exams**

| ST 2021                   | 76-T-MACH-105443 | Wave Propagation               | Seemann |

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

**Competence Certificate**

oral exam, 30 min.

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

**Wave Propagation**

2161219, WS 21/22, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

Blended (On-Site/Online)

**Content**

The course gives an introduction into wave propagation phenomena. This contains both one-dimensional continua (beams, rods, strings) as well as two- and three-dimensional continua. Initial condition problems are treated. Fundamental effects like velocity, group velocity or dispersion are explained. Wave propagation is used to show the limits of structural models like beams. In addition surface waves and acoustic waves are covered.

**Literature**

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<tr>
<td>Oral examination</td>
<td>4</td>
<td>Grade to a third</td>
<td>Each winter term</td>
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**Events**

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<tr>
<th>Event Code</th>
<th>Course Code</th>
<th>Course Name</th>
<th>SWS</th>
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<tr>
<td>WT 21/22</td>
<td>2173571</td>
<td>Welding Technology</td>
<td>2</td>
<td>Block /</td>
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**Competence Certificate**

Oral exam, about 20 minutes

**Prerequisites**

none

**Recommendation**

Basics of material science (iron- and non-iron alloys), materials, processes and production, design.

All the relevant books of the German Welding Institute (DVS: Deutscher Verband für Schweißen und verwandte Verfahren) in the field of welding and joining is recommended.

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

**Welding Technology**

2173571, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)
Content
definition, application and differentiation: welding,
welding processes, alternative connecting technologies.
history of welding technology
sources of energy for welding processes
Survey: Fusion welding,
pressure welding,
weld seam preparation/design
welding positions
weldability
gas welding, thermal cutting, manual metal-arc welding
submerged arc welding
gas-shielded metal-arc welding, friction stir welding, laser beam and electron beam welding, other fusion and pressure welding processes
static and cyclic behavior of welded joints,
fatigue life improvement techniques
learning objectives:
The students have knowledge and understanding of the most important welding processes and its industrial application.
They are able to recognize, understand and handle problems occurring during the application of different welding processes relating to design, material and production.
They know the classification and the importance of welding technology within the scope of connecting processes (advantages/ disadvantages, alternatives).
The students will understand the influence of weld quality on the performance and behavior of welded joints under static and cyclic load.
How the fatigue life of welded joints could be increased, will be part of the course.
requirements:
basics of material science ( iron- and non-iron alloys), of electrical engineering, of production processes.
workload:
The workload for the lecture Welding Technology is 120 h per semester and consists of the presence during the lecture (18 h) as well as preparation and rework time at home (102 h).
exam:
oral, ca. 20 minutes, no auxiliary material
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

angenommenen 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.
# 7.256 Course: Windpower [T-MACH-105234]

**Responsible:** Norbert Lewald  
**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>
<thead>
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## Events

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<td>WT 21/22</td>
<td>2 SWS</td>
<td>/ 🧩</td>
<td>Lewald, Pritz</td>
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## Exams

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<td>Windpower</td>
<td>Lewald, Pritz</td>
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<td>Windpower</td>
<td>Lewald</td>
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**Competence Certificate**  
written exam, 120 minutes

**Prerequisites**  
none

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

**Windpower**  
2157381, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)  
Blended (On-Site/Online)
7.257 Course: Working Methods in Mechanical Engineering [T-MACH-105296]

**Responsible:** Prof. Dr.-Ing. Barbara Deml

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102576 - Key Competences

<table>
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**Events**

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**Exams**

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<th>Working Techniques for Mechanical Engineering</th>
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<tr>
<td>ST 2021</td>
<td>76-T-MACH-105296-englisch</td>
<td>Working Methods in Mechanical Engineering</td>
<td>Deml</td>
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</table>

**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

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

**Working Methods in Mechanical Engineering**

2110969, SS 2021, 1 SWS, Language: English, Open in study portal

**Organizational issues**

The course addresses students in the Bachelor program Mechanical Engineering in the fourth semester. Students in the Bachelor program Mechanical Engineering in the second semester, as well as students in the Master program Mechanical Engineering or other programs, may participate in case of vacancies. The lecture consists of an e-learning course, combined with an online exam and accompanying self-study over the entire lecture period.
**T.258 Course: Workshop on Computer-based Flow Measurement Techniques [T-MACH-106707]**

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

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology

<table>
<thead>
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<th>Type</th>
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<td>Each term</td>
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**Events**

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<th>Recurrence</th>
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<td>2171488</td>
<td>Workshop on computer-based flow measurement techniques</td>
<td>3 SWS</td>
<td>Practical course /</td>
<td>Bauer, Mitarbeiter</td>
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<tr>
<td>WT 21/22</td>
<td>2171488</td>
<td>Workshop on computer-based flow measurement techniques</td>
<td>3 SWS</td>
<td>Practical course /</td>
<td>Bauer, Mitarbeiter</td>
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**Exams**

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<td>Workshop on computer-based flow measurement techniques</td>
<td>Bauer</td>
<td></td>
</tr>
</tbody>
</table>

**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**

<table>
<thead>
<tr>
<th>Type</th>
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<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<tr>
<td>On-Site</td>
<td></td>
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</table>

2171488, SS 2021, 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.

Basic design of measurements systems

- Logging devices and sensors
- Analog to digital conversion
- Program design and programming methods using LabView
- Data handling
- Bus systems
- Design of a computer aided data acquisition system for pressure, temperature and derived parameters
- Frequency analysis
- 

regular attendance: 52,5
self-study: 67,5

The students are able to:

- theoretically describe and explain the fundamentals of computer aided measurements and and adopt them practically
- apply the basics learned during the lecture to a practical problem in the form of a PC exercise

Group colloquia for each topic

Duration: approximately 10 minutes

no tools or reference materials may be used

Organizational issues
Der aktuelle Status wird auf der ITS-homepage bekannt gegeben.

Literature
Germer, H.; Wefers, N.: Meßelektronik, Bd. 1, 1985
LabView User Manual
Hoffmann, Jörg: Taschenbuch der Messtechnik, 6., aktualisierte. Aufl., 2011

Workshop on computer-based flow measurement techniques
2171488, WS 21/22, 3 SWS, Language: German, Open in study portal
Content
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- Data handling
- Bus systems
- Design of a computer aided data acquisition system for pressure, temperature and derived parameters
- frequency analysis

regular attendance: 52,5
self-study: 67,5

Lernziele:
Die Studenten können:

- die wesentlichen Grundlagen der rechnergestützen Messwerterfassung theoretisch beschreiben und praktisch anwenden
- nach jedem Lernabschnitt den vorgestellten Stoff anhand eines Beispiels am PC in die Praxis umsetzen

The students are able to:

- theoretically describe and explain the fundamentals of computer aided measurements and and adopt them practically
- apply the basics learned during the lecture to a practical problem in the form of a PC exercise

Group colloquia for each topic

Duration: approximately 10 minutes

no tools or reference materials may be used

Organizational issues
Ort und Zeit siehe Institutshomepage.
Praktikum findet in Präsenz statt, sofern die COVID-Inzidenzwerte es zulassen.

Literature
Germer, H.; Wefers, N.: Meßelektronik, Bd. 1, 1985
LabView User Manual
Hoffmann, Jörg: Taschenbuch der Messtechnik, 6., aktualisierte. Aufl., 2011